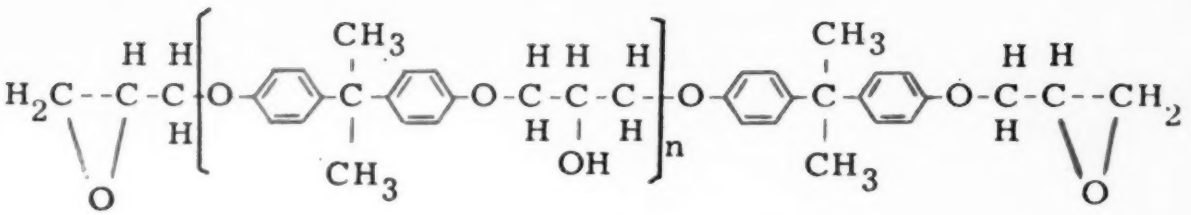
MINING WORLD

MARCH
1960



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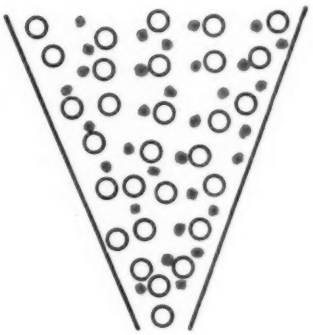

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DRILLING BERYL

from high temperature vein p. 44

Also:

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For African Mine p. 42

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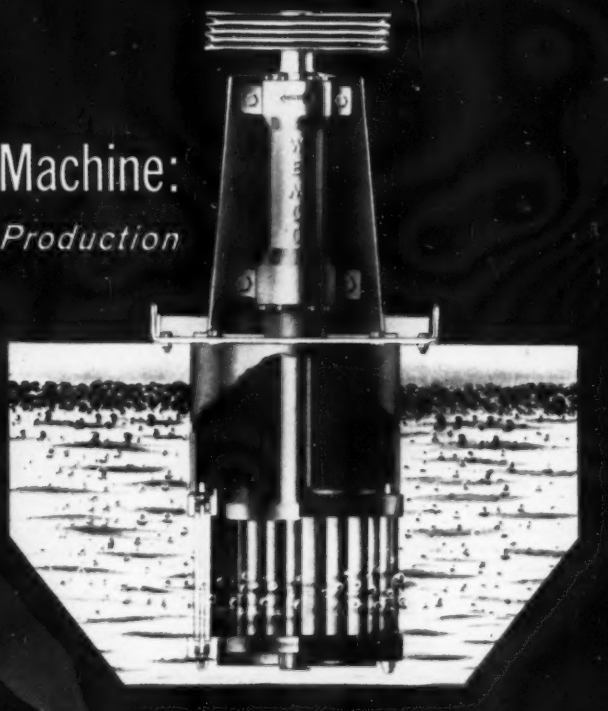

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Now optional for the DW20, the SynchroTouch Transmission Control is an advanced new way to shift gears faster and easier. The operator simply dials desired gear for automatic, split-second, touch-and-go response. Result: faster cycles and more payloads per hour.

With all its improvements, the new DW20-No. 456 meets your needs for moving more dirt at lower cost. See this high-capacity hauler at your Caterpillar Dealer. Ask him to demonstrate. Pick a tough job—watch it handle the hard work!

Caterpillar Tractor Co., General Offices, Peoria, Illinois, U. S. A.

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HAUL AT LOWEST COST PER CU. YD.

MINING WORLD

. . . . . including the Export Edition, WORLD MINING

VOL. 22 NO. 3

March 1960

Southern Pacific's exploration program in the Buena Vista Hills district of Nevada has indicated 132,000,000 tons of low grade iron ore. Beneficiation tests have shown that a high grade concentrate can be produced by coarse grinding and magnetic concentration 26

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MILLER FREEMAN PUBLICATIONS

NO MAJOR REPAIRS IN 25 YEARS*

Sturtevant Construction Assures Long Mill Life at Top Loads

Sturtevant crushing and grinding machinery answers the long life top-load production problem for medium to small size plants. Many Sturtevants have been operating above rated capacities for more than 25 years, and *without a major repair.*

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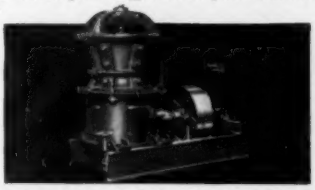
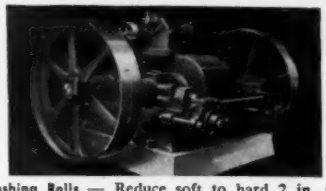


Rotary Fine Crusher — Reduce soft to medium hard 3 to 8 in. material down to ¼ to 1¼ in. sizes. Capacities up to 30 tph. Smallest model has 6 x 18 in. hopper opening; largest, 10 x 30 in. Non-clogging operation. Single handwheel regulates size. *Request Bulletin No. 063.*



Crushing Rolls — Reduce soft to hard 2 in. and smaller materials to from 12 to 20 mesh with minimum fines. Eight sizes, with rolls from 8 x 5 in. to 38 x 20 in.; rates to 87 tph. Three types — Balanced Rolls; Plain Balanced Rolls; Laboratory Rolls — all may be adjusted in operation. *Request Bulletin No. 065.*

Hammer Mills — Reduce to 20 mesh. Swing-Sledge Mills crush or shred medium hard material up to 70 tph. Hinged-Hammer Pulverizers crush or shred softer material at rates up to 30 tph. Four Swing-Sledge Mills with feed openings from 6 x 5 in. to 20 x 30½ in. Four Hinged-Hammer Pulverizers with feed openings from 12 x 12 in. to 12½ x 24 in. *Request Bulletin No. 084.*

**Reports Manager W. Carleton Merrill concerning Sturtevant Swing-Sledge Mill at James F. Morse Co., Boston.*

STURTEVANT MILL COMPANY
157 Clayton St., Boston 22, Mass.

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Unknown In U. S. Too

Russian claims for metal production, mineral discoveries, and world record mining performances continue to be most impressive.

The recent Russian claim by the chief engineer of the All-Union Explosives Trust, about a stripping blast in Siberia is worth evaluating. He reports that 55,588 tons of explosives would be loaded in 44 holes with an average depth of 49 yards to break overburden over thick coal beds.

This is equivalent to 1,263 tons of explosive per hole, or 8.59 tons per foot of depth. Explosives weigh from 50 to 90 pounds per cubic foot. Using 70 pounds per cubic foot as an average factor it would take 246 cubic feet to hold powder. This would require a drill hole with a 17.7 foot diameter.

Some hole! Some blast! No wonder the Russian engineer said, "We have not before made such deep trenches, and they are unknown in world practice either."

Such are Russian mining boasts.

Zinc Sanity Ahead?

World lead and zinc producers have accomplished much during the past year in voluntarily holding mine production in line with demand. Particularly with zinc where a more realistic price now prevails. Forecasts are for accelerated zinc demand so production curbs have been removed.

From stope to refinery, from Australia to Yugoslavia, more zinc is flowing to market.

Overproduction in months ahead will put mining industry right back where it was several years ago. Zinc statesmanship must prevent this again.

Watch For Yearbook

This is an early report on the annual MINING WORLD Yearbook Catalog, Survey and Directory Number which is published in April every year.

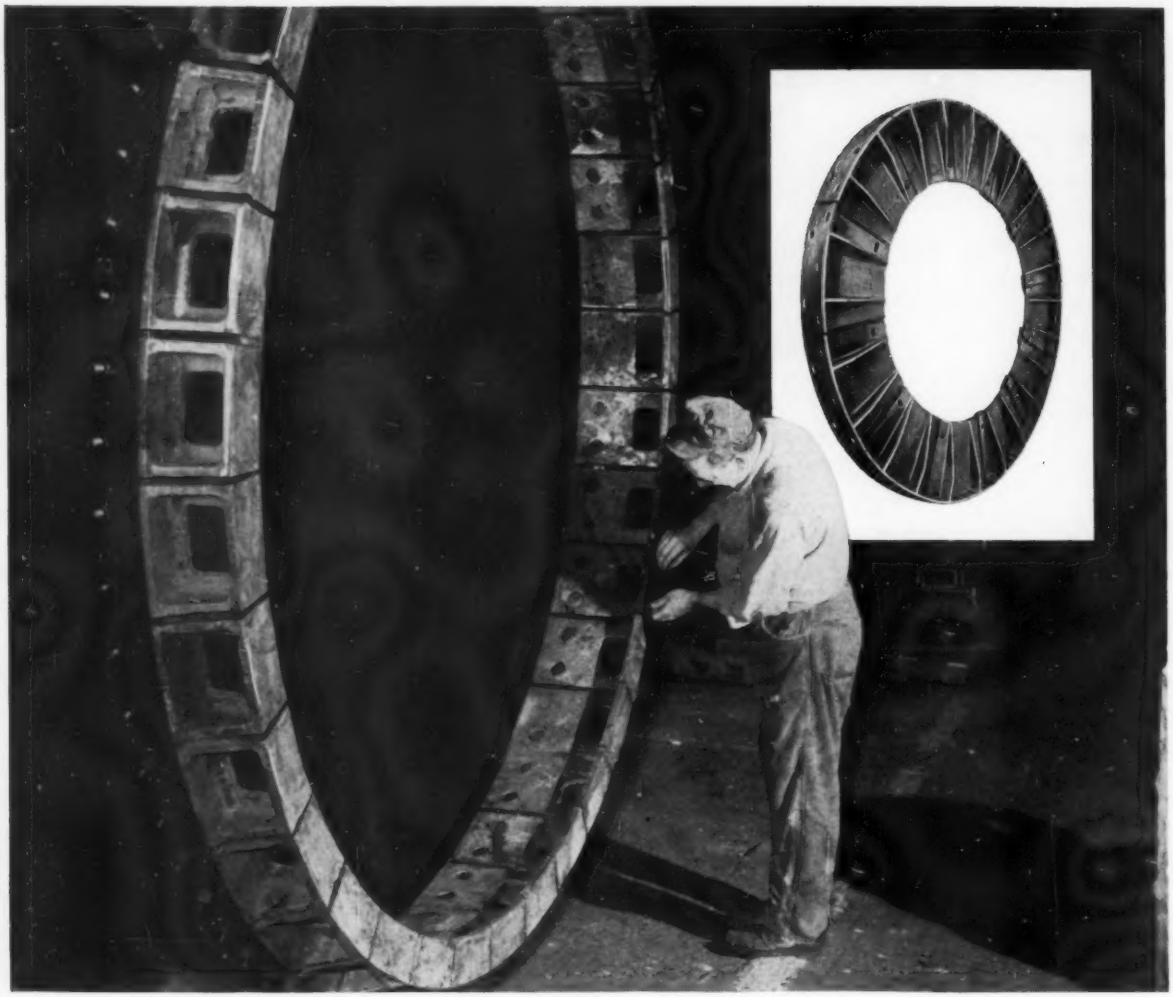
Again, it will be the industry's most useful and widely read single mining issue and reference catalog.

So valuable have the various special sections become to the mining and metallurgical world that no major changes are planned from the regular sections.

The Directory of United States Mines, the Ore Buyers Guide, and the Index of Equipment and Manufacturers, so long industry favorites, will be found in their normal place.

Information on metals, mining companies, ore discoveries, European metallurgical developments, tonnages mined, and thousands of other developments around the world is pouring into the Editorial office.

The mining industry's slogan, "You can find it in MINING WORLD," is the best description of the forthcoming issue.



IN CEMENT, LIME, AND DOLOMITE PLANTS...

B&W Nose and Tail-Ring Castings Demonstrate Longer Continuous Service

Longer brick life and longer continuous service are being attained by 275 kilns in 54 plants using B&W Nose and Tail-Ring Castings. In many cases, the life of these castings has exceeded 9 years.

Light and strong B&W Alloy Castings have improved kiln performance in most installations. Made of heat-resisting Grade HH alloy, nose ring castings eliminate belling out of the kiln shell, assuring longer brick life and longer continuous operation of the kiln. By protecting the end of the kiln shell from direct flame, the nose ring castings prevent "feathering-down" of the shell because of oxidation. Their design eliminates cracking and warping, experienced with large size castings.

Small size and light weight make B&W Castings easy and inexpensive to install. The protecting flange on the nose ring castings permits the use of low-alloy steel bolts for fastening.

Spare part inventory may be kept low because the same nose ring castings may be used on kilns varying up to 4 feet in diameter, depending upon size. Write for Bulletin S-17. The Babcock & Wilcox Company, Boiler Division, Barberton, Ohio.

B&W

THE BABCOCK & WILCOX COMPANY

BOILER DIVISION

S-467

CAPITOL CONCENTRATES

Wilderness Bill Faces Delay

Secretary of Interior Fred A. Seaton has expressed the opinion that Congress may wait for a year before acting on the so-called wilderness legislation. He based his opinion on the fact that the final report of the Outdoor Recreation Resources Commission is not due until 1961. "My guess is the bill won't see final form until after that report is submitted," he added.

The bill referred to is S. 1123 which seeks the establishment of a National Wilderness Preservation System composed of federally owned or controlled land and water areas for the "use and enjoyment of the people in such a manner as will leave them unimpaired for future use and enjoyment as wilderness." The bill has drawn heavy fire from cattle, mining, and timber interests; and highly vocal support from recreation and conservation groups.

Mining's Absence Is Noted

Extensive hearings have been held by the Senate Interior Committee on S. 2549, a bill introduced by Senator James E. Murray of Montana and 30 other Senators, termed "National Policy on Conservation of Natural Resources." Although the bill ostensibly covers the entire natural resources field and would require the President to furnish annually to the Congress a comprehensive "Resources and Conservation" report, the minerals industries are not specifically mentioned. It is true that they would come under the general heading of natural resources; other resources, though, are referred to in considerable detail. Further, and oddly enough, no mining organization appeared for or against the bill. This is particularly curious in the case of a bill with such a distinguished list of sponsors, at least 14 of whom generally are deeply interested in coal, oil, gas, metallic, and non-metallic minerals.

Subsidy Bills May Be Offered

Rumors indicate that bills will be introduced both in the House and the Senate proposing to subsidize a long list of domestic minerals. The formula to be followed is that of the so-called Seaton Stabilization Plan which once was passed by the Senate and rejected by the House. Probably more minerals will be included than were in the original Seaton bill.

Consider International Agreements

According to the Director of the Mint, "All gold transactions of the Treasury since 1934 have been made at $35.00." Moreover, the Bretton Woods Agreement of 1945 in substance terminated the power of the Secretary of the Treasury to buy or sell gold at any other than the established price of $35.00 per ounce (22 U.S.C 286 and 286C). Even if the Treasury Department were willing to approve a bill to alter the monetary price of gold (which is most unlikely), international agreements which we have ratified make conditions more complex than most people realize, or who think all that is necessary is to pass a simple bill to raise the price of gold.

It must be noted that in Title 22, 286C, there is a specific statement to the effect that "unless Congress by law authorizes such action, neither the President nor any person or agency shall on behalf of the United States (b) propose or agree to any change in the par value of the United States dollar under Article IV, Section 5, or Article XX, Section 4, of the articles of agreement of the Fund, or approve any changes in par value under Article IV, Section 7."

The Articles of Agreement are deposited in the archives of the Department of State. These agreements are so complex and so interlocked with foreign currencies and commitments to the sterling bloc that it is difficult to see how the Congress could merely withdraw from the Bretton Woods Agreement, without widespread concurrence by other signatories, and authorize a "change in the par value of the United States dollar" which, certainly, a revaluation of gold would accomplish.

The subsidy approach would seem to be the more practical one.

Trend Toward Subsidies Grows

In discussing the mining situation before the United States Tariff Commission, the American Metal Climax, Inc., filed the following opinion: " . . . . . if it is assumed that the government should give more assistance to the industry than is afforded by continuance in effect of the present rates of duty, the best means, we are convinced, is by a carefully framed and administered system of direct subsidization. What such a system, so framed and so administered, would cost the public as taxpayers would be only a fraction of what it would cost the public as consumers (not to mention other objections) if the government were to rely on additional tariff or other restrictions upon imports as a means of attaining the same end."

Apparently the threat of tariff or quota increases is making many companies look with kindness upon some variation of the old Premium Price Plan. This Plan, it was once calculated, saved the consumers 10 times what it cost.

Mine Preservation Bills Introduced

Measures titled the "National Mines Preservation Act of 1960" have been introduced in Congress as S. 2858 by Senator James E. Murray of Montana, and H. R. 9598 by Representative Walter S. Bearing of Nevada. These bills would set up a method whereby mine operators could obtain funds from the government for maintenance where low prices cause a shut-down and the company no longer can afford to keep the mine open.

The necessity for such a plan was indicated by testimony given recently before the United States Tariff Commission by the president of the Tri-State Ore Producers Association. He stated that in his area some 25 mines now shut down require pumping to the tune of about $750,000 per year. He also commented that some of these properties may have to be abandoned. The situation is equally serious in other parts of the country.

A second bill by Representative Baring—H. R. 9597—

is titled the "Domestic Minerals Act of 1960." It provides a general formula for maintaining production of a mine where it is determined that the production of "any metallic or nonmetallic mineral is being or has been reduced because of the importation of competing products or because of economic conditions." The formula is flexible enough to take care of all minerals and conditions by means of import quotas, across-the-board or individual mine incentive payments, or barter contracts. While the bill would do the job for domestic producers, it is likely to be quite controversial.

Review Of Gold Case Refused

The United States Supreme Court has refused to review the case of a California gold-mine owner who claimed the Gold Reserve Act of 1934 is unconstitutional on the grounds that, if the mine owner has title to the gold in a mine, he equally has title to it after it is extracted; hence the government has no right to, in effect, confiscate it at a fixed price. The theory was most ingenious and sounds logical, but the Supreme Court sometimes decides cases on grounds of expediency rather than logic.

No Substantial Injury

A decision has been made by the United States Tariff Commission on the escape-clause application in the zinc sheet import case. As was rather expected, the commission split on the matter 3 to 2. The decision to make no recommendation to the President was based on the finding that no substantial injury is being caused by imports.

However, the minority report violently disagreed with the majority and stated, "it is our view that the foregoing facts considered in the light of escape-clause criteria show that zinc in sheets (including coated or plated sheets) dutiable under paragraph 394 of the Tariff Act of 1930, as amended, is being imported into the United States in such increased quantities, both actual and relative, as to cause serious injury to the domestic industry producing the like product; and that an increase in duty of 45 percent ad valorum is necessary to remedy the injury."

The majority also stated that this problem is part of the whole zinc industry study which is being undertaken at the request of the Senate Finance Committee.

Silver Shortage Increases

According to Mocatta & Goldsmith, London bullion merchants, the shortage of silver in the last quarter of 1959 amounted to "almost a silver famine". The Canadian Mint placed buying orders for silver in London for the first time on record, and bought 1,000,000 ounces. As the year closed the London quotation was 80.25 pence per ounce, a top price. The French are reported to be in the market for 2,000 tons of silver for the new "heavy franc", but these purchases no doubt will be spread over a period of time. These events would indicate that it may not be too long before the United States Treasury will have to go into the market and buy silver or retire some silver certificates to release bullion for sale and subsidiary coinage. The latter course seems most likely.

Foreign Lead Zinc Pressure Continues

As has been predicted in these columns several times, more and more pressure is being put on the United States to rescind the lead-zinc quota order. Australia and Canada have made strong representations during the GATT meeting in Tokyo and are threatening reprisals. Mexico has been complaining for some time.

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LIVERMORE, CALIFORNIA

COMING CONVENTIONS

April 6 and 7. The 32nd annual meeting of the LEAD INDUSTRIES ASSOCIATION, Chase-Park Plaza Hotels, St. Louis, Missouri.

April 7 and 8. The 42nd annual meeting of the AMERICAN ZINC INSTITUTE, Chase-Park Plaza Hotels, St. Louis, Missouri.

April 11, 12, and 13. Fifth annual Alaskan Minerals Conference sponsored by the University of Alaska and the Alaskan sections of the AIME. University of Alaska, College.

April 14 and 15. Annual meeting of the LAKE SUPERIOR INSTITUTE OF GEOLOGY, Wisconsin Center, University of Wisconsin, Madison, Wisconsin.

April 21, 22, and 23. The NATIONAL WESTERN MINING CONFERENCE sponsored by the Colorado Mining Association and affiliated groups. New Hilton Hotel, Denver, Colorado.

April 21, 22, and 23, 1960. SOUTHWEST METALS AND MINERALS CONFERENCE, sponsored by the AIME and the Rock Products Association of southern California, Ambassador Hotel, Los Angeles, California.

April 28, 29, and 30. Annual NORTHWEST METALS AND MINERALS CONFERENCE sponsored by the AIME. Sheraton Hotel, Portland, Oregon.

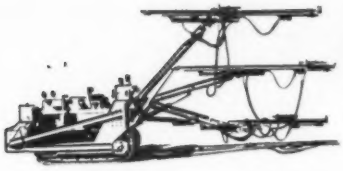
May 2 to 5. Conference on the METHODS OF REDUCING IRON ORES, the Electrochemical Society's Electrothermics and Metallurgical Division as sponsor. LaSalle Hotel, Chicago, Illinois.

May 16 to 20. INTERNATIONAL STRATA CONTROL CONFERENCE. Centre Marcelin Berthelot (Maison de la Chimie), 28 bis, rue Saint Dominique, Paris 7e, France.

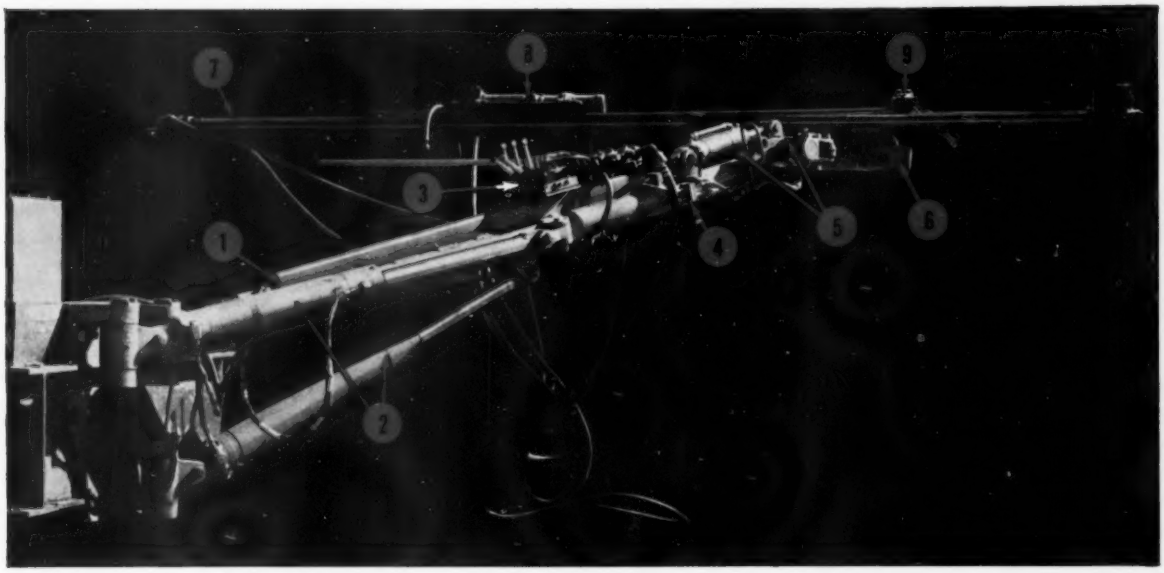
May 23 and 26. Symposium on REFRACTORY MATERIALS AND ALLOYS, sponsored by the AIME. Wayne State University, Detroit, Michigan.

June 9 and 10. COLUMBIUM METALLURGICAL SYMPOSIUM sponsored by the Hudson-Mohawk section of the AIME. Lake George, New York.

October 17 through 21. The 48th annual NATIONAL SAFETY CONGRESS, Conrad Hilton Hotel, Chicago, Illinois.



Here's Why HYDRA-BOOMS make BETTER JUMBOS



Ingersoll-Rand Hydra-Booms are hydraulically-operated drill mountings that are designed and built not only for greatest ease of operation, but for maximum *safety* and *dependability* as well. Check and compare these Hydra-Boom features — then make sure your next jumbo has all these advantages for faster, safer drilling.

1. **HOSE SHIELD** welded to boom, protects air and hydraulic hoses against damage. Simpler, neater and safer.

2. **SAFETY-LOCK CYLINDERS** — big, powerful, double-acting for fast operation in either direction. Safety-lock check valves prevent creeping or dropping of booms.

3. **BOOM-MOUNTED OR REMOTE CONTROLS** — can be mounted wherever desired. For fully centralized operation, they can be combined with remote drill controls.

4. **HYDRAULIC JUNCTION BOXES** — short hydraulic connections from end of boom simplify replacement in case of wear or damage.

5. **POWER DUMP & SWING** — separate cylinders move drill guide to any position at the touch of a control valve.

6. **PROTECTIVE SHIELD** over end of drill-feed extension cylinder prevents damage to the hydraulic connection—otherwise a vulnerable spot.

7. **SCREW OR CHAIN FEEDS** — Ingersoll-Rand can supply reversible aluminum-shell screw feeds from 30" to 144", as well as air-driven chain feeds to any practical length.

8. **FULL LINE OF HEAVY-DUTY DRIFTERS** — with the right combination of weight, power and bore size for any application.

9. **TRAVELING CENTRALIZER** prevents whipping and fatigue of drill steels, assuring substantially longer rod life.

In addition, Ingersoll-Rand has pioneered in the development of the following equipment for tunneling and mining jumbos and can meet your exact requirements for any job.

BURN-CUT "PACKAGE" — Ingersoll-Rand Downhole Drill, air-powered rotary head, chain feed and large-diameter Carset bit for drilling a central burn cut. Permits pulling longer rounds and gives improved fragmentation with less powder.

AIR PREHEATER — Specially designed electric heating units pre-heat the drilling air, eliminating fogging at the work face, promoting safer working conditions and providing better drill lubrication.

Ask your Ingersoll-Rand engineer for complete information.

Ingersoll-Rand

103A5 ♥ 11 Broadway, New York 4, N.Y.

A CONSTANT STANDARD OF QUALITY IN EVERYTHING YOU NEED FOR DRILLING ROCK

How granite-bucking TD-20 wins tough quarry job!

—for Superior Stone Company, Crabtree Creek Quarry, Raleigh, North Carolina

Main reason why it's a TD-20 instead of some competitive rig: the more powerful, stronger-built "20" replaces a past model International TD-18—that set a stand-out record of high availability and low upkeep at this quarry!

The "20" is key equipment in helping feed the 200-ton-per-hour capacity crushing plant at Crabtree Creek Quarry of Superior Stone Company (Division of American Marietta Company).

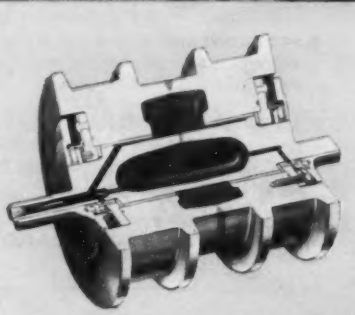
Slamming hard, heavy granite stone around is a main item on this International TD-20's work diet. That and tough over-burden removal, and haul-road maintenance!

"Rock-Bossing" power and strength

The TD-20's engine is a high-torque 134-hp diesel—with 6-cylinder smoothness and International diesel starting ease and economy. Bridge-strong track frames of heavy-duty, gusset-braced, welded box sections form the TD-20's rock-shock-resistant undercarriage.

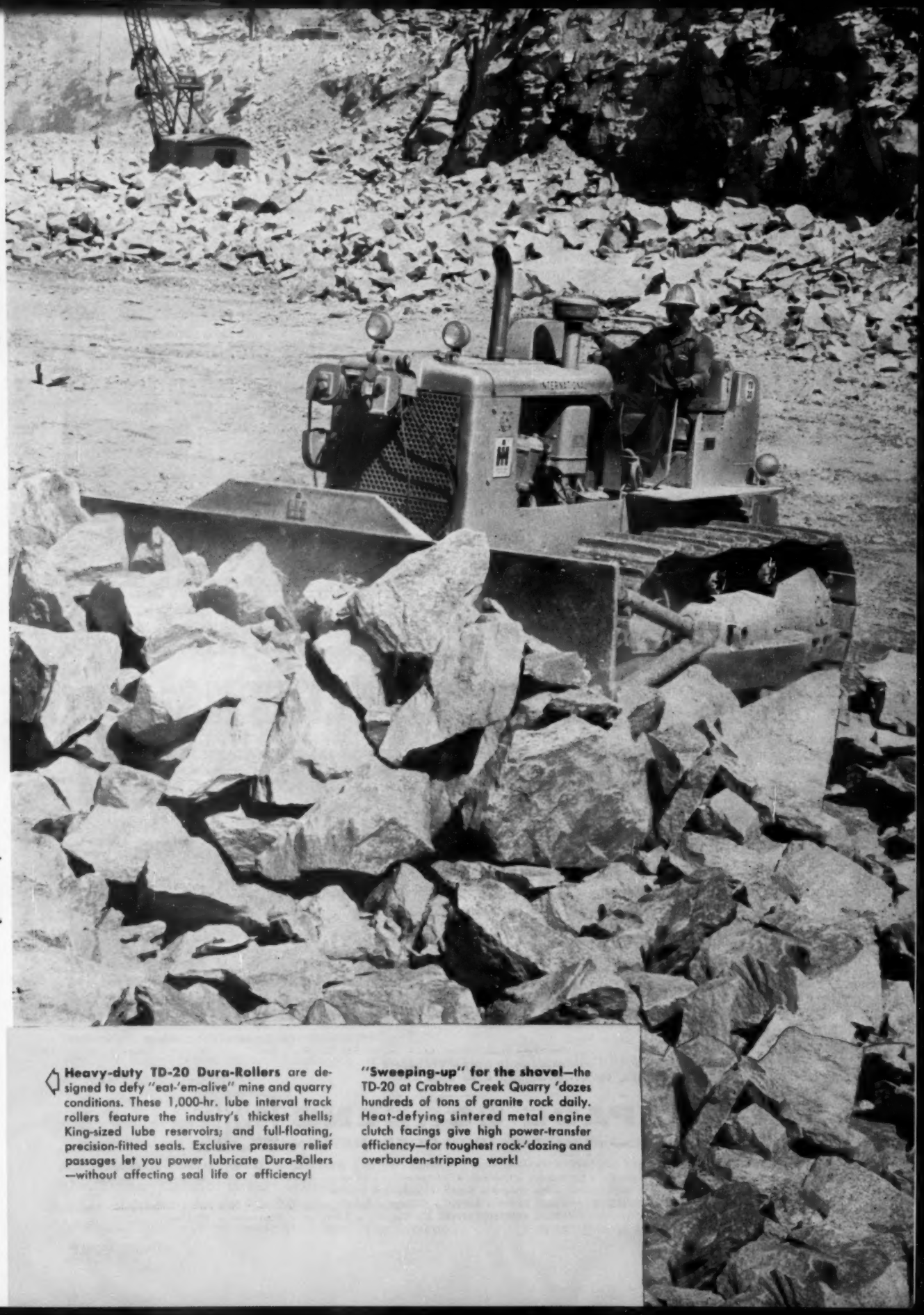
Exclusive International 3-point-mounting allows free track oscillation for rough mine and quarry duty—and maintains positive, life-prolonging alignment. TD-20 weight rides smoothly on thick-shelled Dura-Rollers—the dual-protected track rollers that make, 1,000-hr. lube intervals practical!

Compare TD-20 performance to anything else on tracks—for capacity, economy, and long life. Measure production-boosting features like "single-stick" shift, 6-speed full-reverse transmission; and cycle-speeding Shuttle-Bar control. See your International Construction Equipment Distributor for a demonstration.



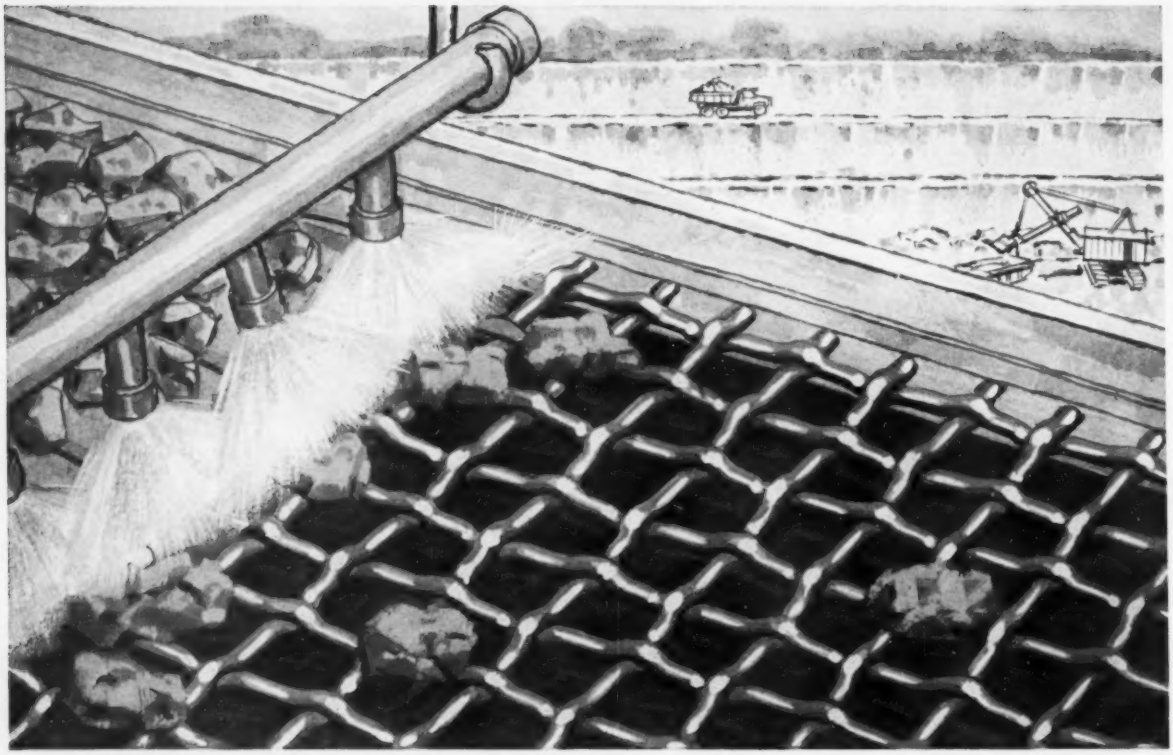
International® *Construction Equipment*

International Harvester Co.,
180 North Michigan Ave., Chicago 1, Illinois
A COMPLETE POWER PACKAGE



Heavy-duty TD-20 Dura-Rollers are designed to defy "eat-'em-alive" mine and quarry conditions. These 1,000-hr. lube interval track rollers feature the industry's thickest shells; King-sized lube reservoirs; and full-floating, precision-fitted seals. Exclusive pressure relief passages let you power lubricate Dura-Rollers —without affecting seal life or efficiency!

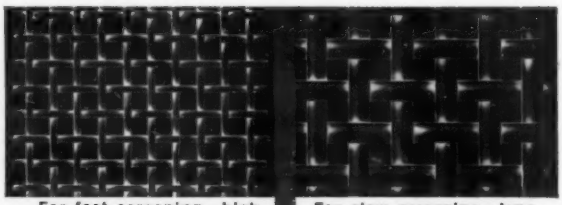
"Sweeping-up" for the shovel—the TD-20 at Crabtree Creek Quarry 'dozes hundreds of tons of granite rock daily. Heat-defying sintered metal engine clutch facings give high power-transfer efficiency—for toughest rock-'dozing and overburden-stripping work!



High throughput? Long service life?

CF&I SPACE SCREENS FILL EITHER REQUIREMENT

To meet the varying operational requirements throughout the Mining industry, CF&I Space Screens are produced in a great variety of weaves, crimps and edge preparations. Wire sizes range up to 1", with screen openings as large as 6". The capability of CF&I to provide the exact screen you need is another one of the meanings represented by our Corporate Image.



For fast screening – high throughput. Effective open area 60%.

For slow screening – long service life. Effective open area 30%.

Both screens have the same size openings.

For complete information on all types of CF&I Space Screens, contact your local CF&I sales office.

CF&I SPACE SCREENS

THE COLORADO FUEL AND IRON CORPORATION

CF&I STEEL

In the West: **THE COLORADO FUEL AND IRON CORPORATION**—Albuquerque • Amarillo • Billings • Boise • Butte • Denver • El Paso • Farmington (N.M.) Ft. Worth • Fresno • Houston • Kansas City • Lincoln • Los Angeles • Oakland • Oklahoma City • Phoenix • Portland • Pueblo • Sacramento • Salt Lake City San Francisco • San Leandro • Seattle • Spokane • Wichita

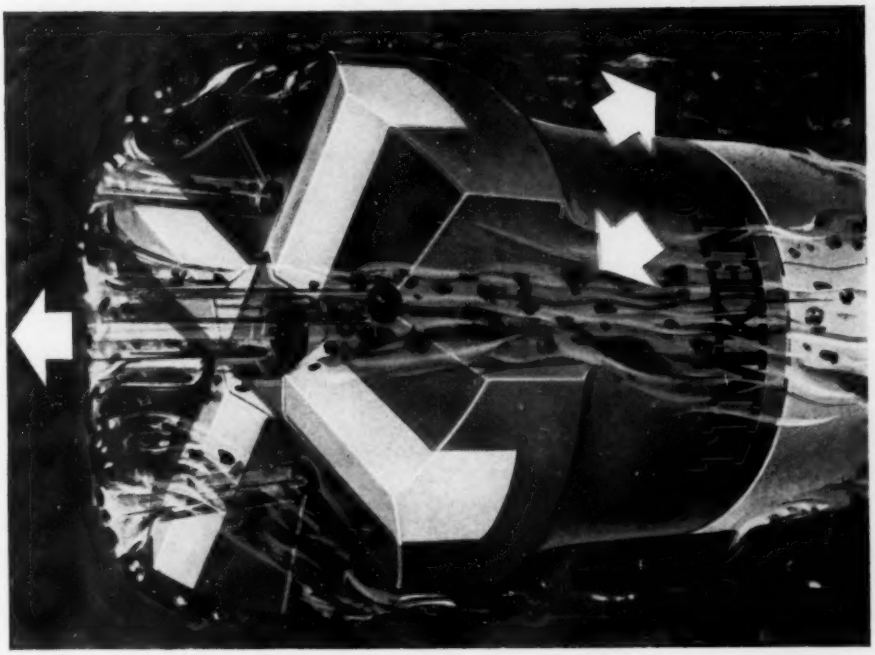
In the East: **WICKWIRE SPENCER STEEL DIVISION**—Atlanta • Boston • Buffalo • Chicago • Detroit • New Orleans • New York • Philadelphia

CF&I OFFICE IN CANADA: Montreal **CANADIAN REPRESENTATIVES AT:** Calgary • Edmonton • Vancouver • Winnipeg

7565

WIDER WING CLEARANCE

ALL AIR OR WATER SHOOTS FORWARD



Timken® threaded bits

CLEAR CHIPS FASTER

When you drill, you want to drill rock—not loose chips. You want to prevent wasteful chip-clogging. And you *can,* by using Timken® threaded carbide insert bits. The five front hole design, pioneered by the Timken Company, shoots air or water directly against the rock face to speed chip removal. And with the deeper, wider wing clearance chips clear faster. You save time, speed drilling.

You save in other ways too. The tough, special analysis carbide inserts have better wear resistance. They're deep—can be re-conditioned many times. And bit bodies are made of Timken fine alloy steel for added strength. Result is you get more hole per bit with your drifters, sinkers and stopers.

Timken bits are used by more miners and contractors than any other removable bit. One reason is that with Timken bits you get the kind of "on the job service" from Timken field engineers you can't get anywhere else. Timken threaded bits are available in a complete range of sizes and types. For full details send for free brochure,"Timken Removable Rock Bits". The Timken Roller Bearing Company, Rock Bit Division, Canton 6, Ohio. Cable: "TIMROSCO". Makers of Tapered Roller Bearings, Fine Alloy Steel and Removable Rock Bits.

FOR OTHER TOUGH DRILLING JOBS

ALL-STEEL MULTI-USE

This Timken bit gives lowest cost per foot of hole when you can drill out full increments of steel.

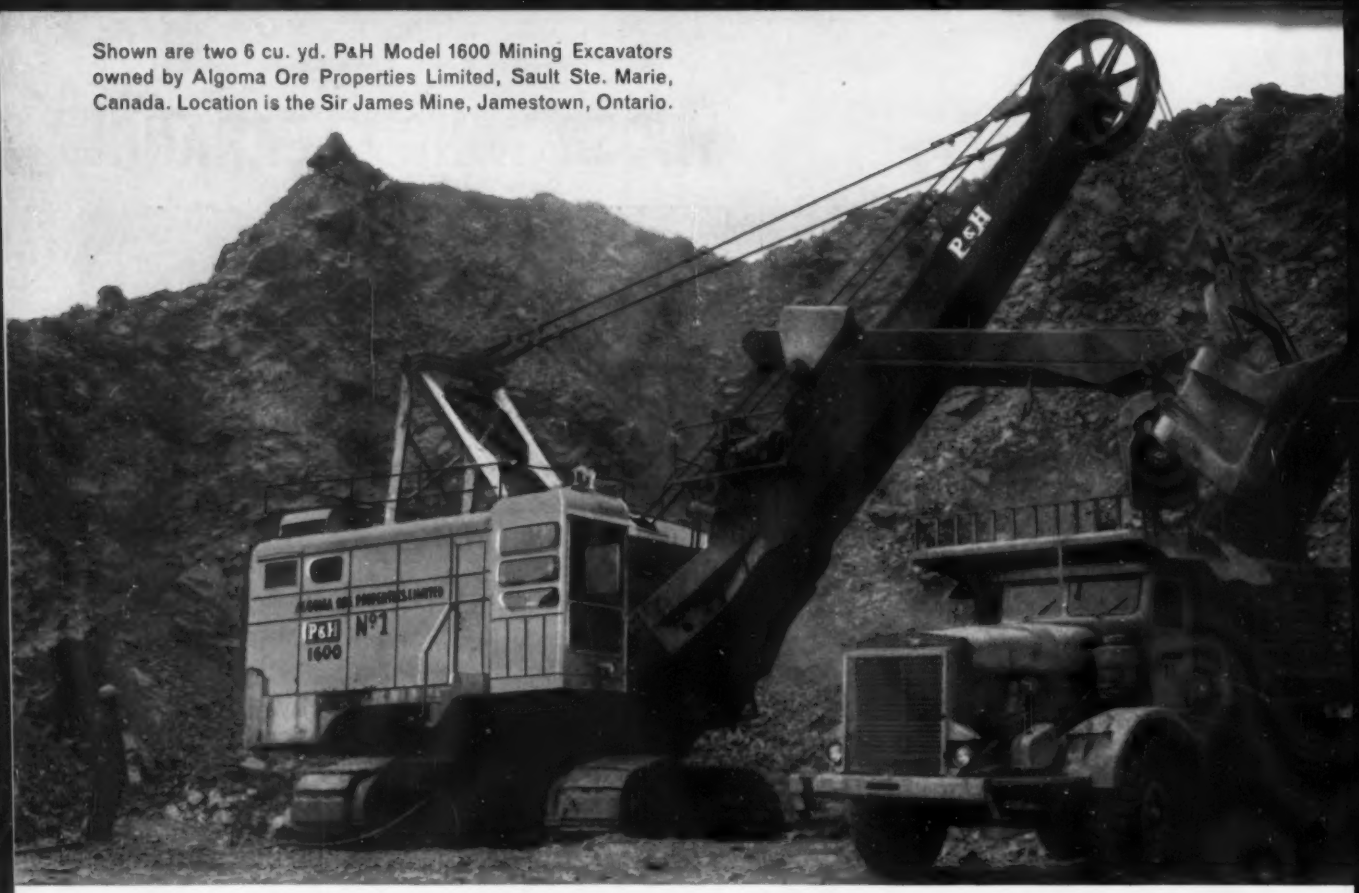
TAPERED SOCKET BIT

Tapered to give strength of one-piece steels. Has the same speedy chip-removal features as the threaded bit shown above.

TIMKEN®

removable rock bits

Shown are two 6 cu. yd. P&H Model 1600 Mining Excavators owned by Algoma Ore Properties Limited, Sault Ste. Marie, Canada. Location is the Sir James Mine, Jamestown, Ontario.



AT ALGOMA ORE PROPERTIES,

LTD.

One P&H always sells another because...

P&H "PROFIT·TONS" reduce loading costs in hardest digging

Up to 30% higher bail pull for more uniform dipper speed in the pile—faster swing—exceptional physical strength of P&H welded construction—greater job availability all add up to as much as 10% more production, lower loading cost per ton and *more net profit* for owners of P&H Electric Mining Excavators on their hardest digging assignment.

P&H "Profit-Tons" are the end product of these *exclusive* P&H design principles:

MAGNETORQUE® . . . the most productive digging motion drive known for electric excavators. This patented P&H hoist drive electro-magnetically transmits the full digging power of an A.C. hoist motor direct to the dipper *without motor generator set conversion to D.C. current.* It gives higher bail pull, greater dipper fill factor and automatic impact protection to the digging machinery.

ELECTRONIC CONTROL . . . this patented P&H control accomplishes the quickest work motion reaction time known on electric shovels. Control maintenance expense is reduced as much as 80% by elimination of all moving parts for a completely closed circuit system.

In addition, with P&H—and only with P&H—do you get the service assurance of single source responsibility. P&H manufactures their own electrical as well as mechanical components—*designed specifically for electric excavator service.* Write Dept. 607A, Harnischfeger Corporation, Milwaukee 46, Wisconsin.

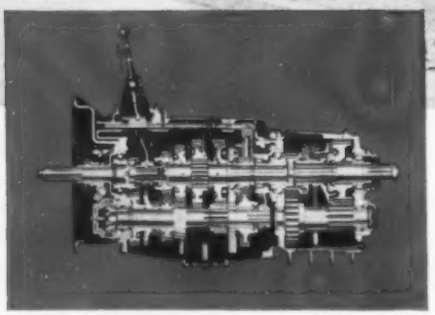
HARNISCHFEGER
Milwaukee 46, Wisconsin

P&H

P&H LINE:

Electric Excavators:	3½ through 10 yds.
Diesel Excavators:	½ through 3½ yds.
Truck Cranes:	10 through 80 tons

P&H equipment is also manufactured in Australia, Brazil, Canada, Germany and Japan.



Wells Overseas, Ltd., an associated company of Wells Cargo, Inc., Reno, Nevada, is using 16 KW-Dart 802-AT Tractors equipped with Fuller R-1160 ROADRANGER Transmissions in iron mining operations 250 miles south of Lima, Peru.

Geared with
FULLER ROADRANGERS

...91-TON LOADS

with double bottoms...

Featuring 9-speed Fuller R-1160 ROADRANGER Transmissions, 16 KW-Dart 802-AT Tractors handle up to 91 tons of iron ore at a time on a mining operation in Peru.

Owned by Wells Overseas, Ltd., the 320 hp KW-Darts use the single-stick, semi-automatic ROADRANGERS to provide maximum performance on the cross-country haul from crusher to the seaport of San Juan. Because the diesel engines can operate in the peak torque and hp range at all times, the 72-mile round trip is made in 3½ hours, including time for loading and unloading.

Ask about the Fuller Transmission designed to boost *your* profits.

STANDARD EQUIPMENT
on Fuller Off-Highway Transmissions

- **COUNTERSHAFT INERTIA BRAKE** . . . for quick, easy upshifts without double clutching . . . faster work cycles
- **PRESSURE LUBRICATION and FILTRATION SYSTEM** . . . for longer gear and bearing life . . . greater availability, less maintenance

FULLER

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MANUFACTURING COMPANY
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Subsidiary EATON Manufacturing Company

Unit Drop Forge Div., Milwaukee 1, Wis. • Shuler Axle Co., Louisville, Ky. (Subsidiary) • Sales & Service, All Products, West. Dist. Branch, Oakland 6, Cal. and Southwest Dist. Office, Tulsa 3, Okla. Automotive Products Company, Ltd., Brock House, Langham Street, London W.1, England, European Representative

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"ore-dressing ideas you can use"

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High Explosives
Permissibles
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Blasting Agents
Blasting Caps
Electric Blasting Caps
Blasting Accessories

SUPERFLOC 16 Flocculant reduces thickener overflow loss by 92.2%...*

recovers many times its cost for Non-Metallic Mineral Producer

At this non-metallic mineral operation, loss of solids in the overflow of a 25′ diameter thickener averaged 19 tons per day. Addition of only 4 lb. per day of SUPERFLOC 16 Flocculant as a 0.1% water solution cut overflow losses to a record low of 1.5 tons per day. While specific gravity of the underflow dropped 10% (75% to 65%) with use of flocculant, there has been no decrease in the throughput and fluidity of thickener underflow is much improved. Values recovered are worth many times the $6.56 daily cost of SUPERFLOC 16.

Previous comparative mill tests showed SUPERFLOC 16 Flocculant to be more effective in cutting overflow losses than other flocculating agents and at ¼ the daily cost of less effective agents.

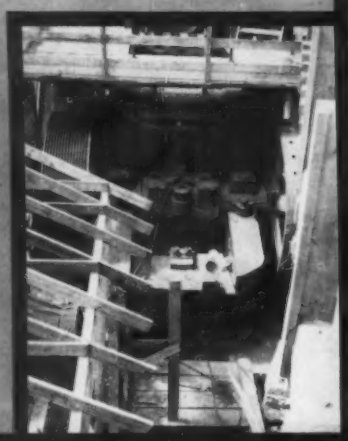
If you have not yet tested SUPERFLOC 16 Flocculant as a settling agent and filter aid, write our nearest office for a test sample and technical data on its use.

*Trademark

AMERICAN CYANAMID COMPANY
EXPLOSIVES AND MINING CHEMICALS DEPARTMENT

CYANAMID INTERNATIONAL — *Mining Chemicals Department*
Cable Address: — Cyanamid, New York

30 ROCKEFELLER PLAZA, NEW YORK 20, N. Y.

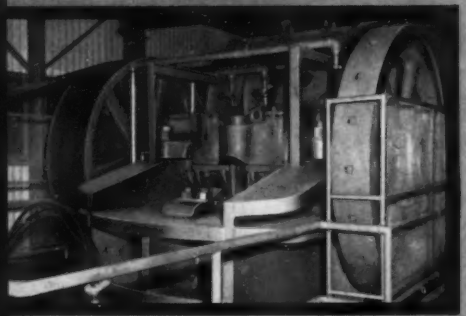


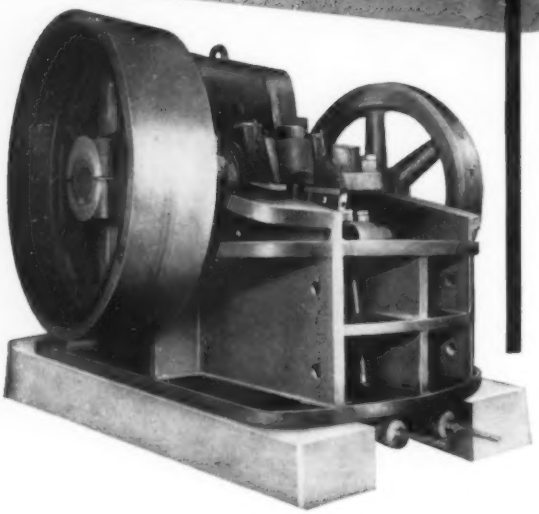
Traylor-made Jaw Crushers offer efficiency and economy

Type HB

Shown above is a Traylor-made 48" x 60" Type HB Jaw Crusher in a stone crushing plant.

A Traylor-made 36" x 42" Type HB Jaw Crusher in a cement plant.





Many operators throughout the world experience daily the economy and rugged dependability of Traylor-made HB Jaw Crushers. Jaw plates are the famous curved type—the pitman shaft is made of annealed open hearth forged steel, light but of great strength. The swing jaw is made of cast steel of extra-heavy box section design to secure maximum strength. These are a few features of the Traylor HB Jaw Crusher. For additional information, write for bulletin No. 5105 today!

Traylor

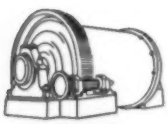
TRAYLOR ENGINEERING & MANUFACTURING DIVISION OF FULLER COMPANY

1522 MILL ST., ALLENTOWN, PA. J 109

FULLER COMPANY GENERAL AMERICAN TRADE MARK

Sales Offices: New York — Chicago — San Francisco

Canadian Mfr.: Canadian Vickers, Ltd., Montreal, P.Q.

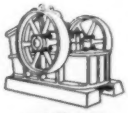


BALL MILLS

ROTARY KILNS

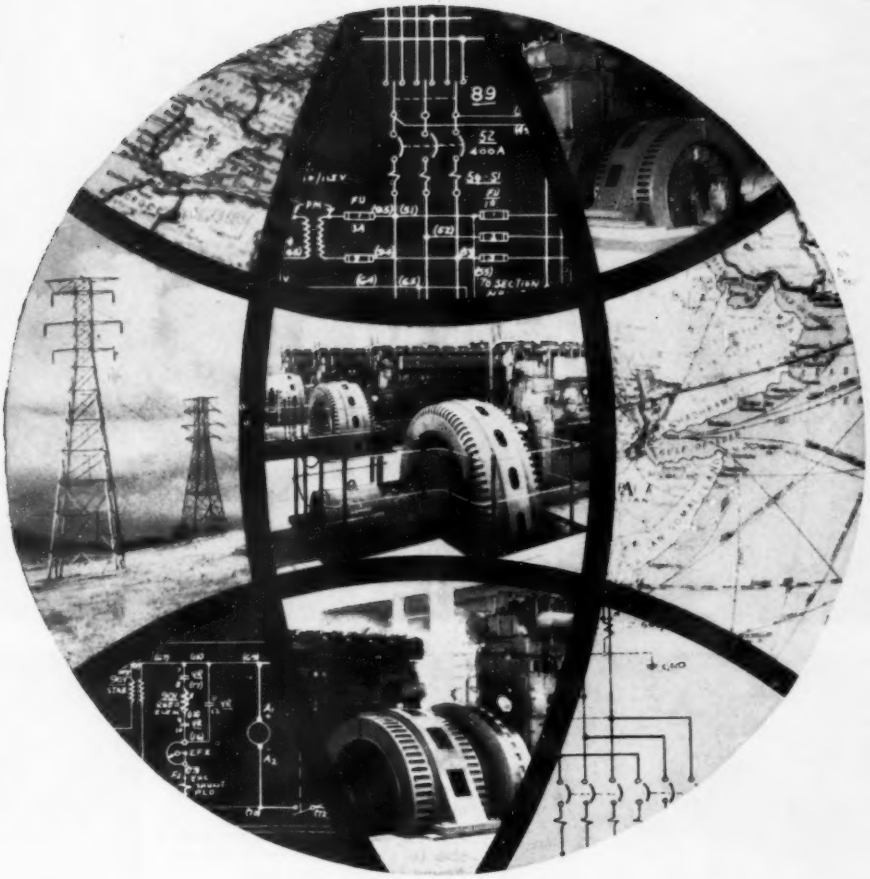
APRON FEEDERS

PRIMARY GYRATORY CRUSHERS



JAW CRUSHERS

SECONDARY GYRATORY CRUSHERS



Chittagong, Bangkok, Teheran, Buenos Aires, in New York City and at the Dew line, we supply your power plant with diesel electric generators of unequaled reliability, rugged construction and high economy on diesel, gas or dual fuel. Our proof? Hundreds of plants all over the world. Send coupon now:

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Title_____

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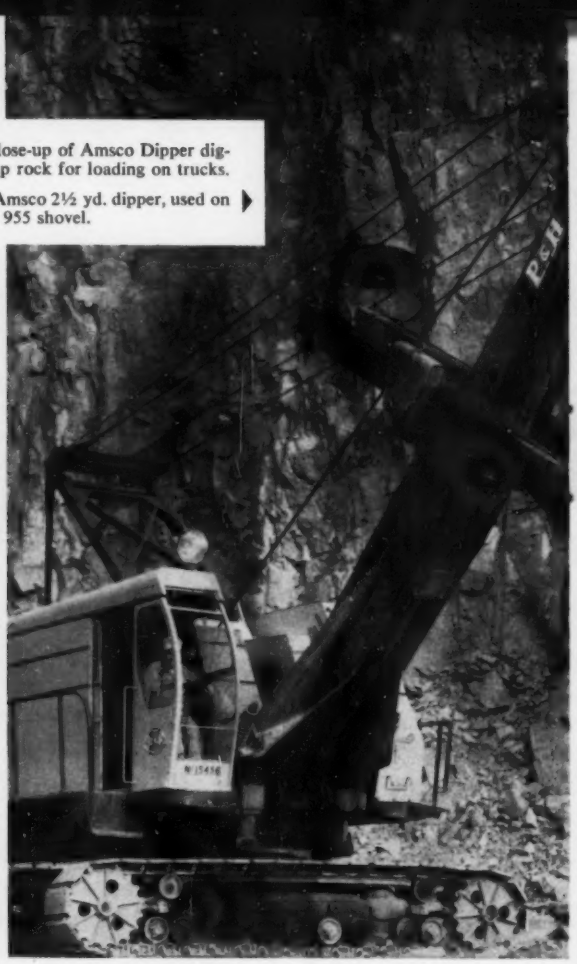
Address_____

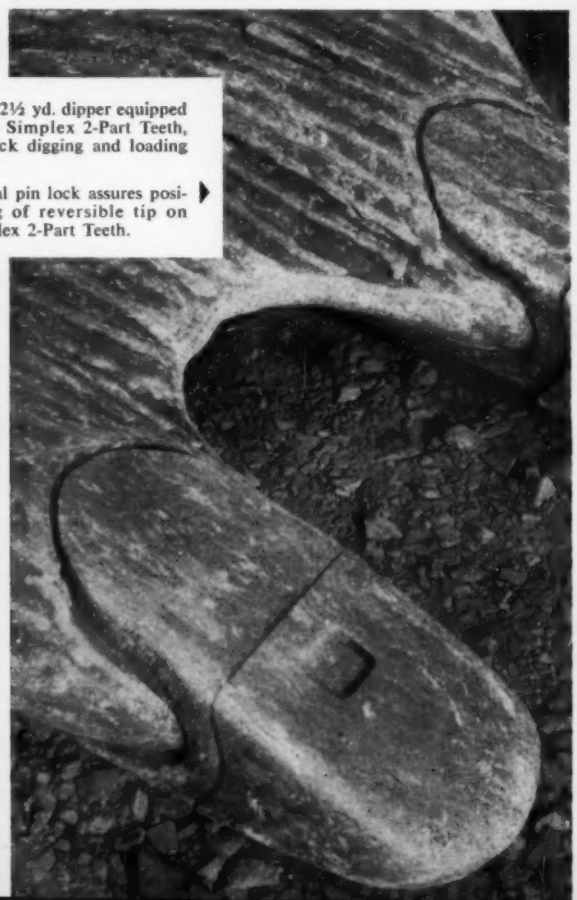
Left: Close-up of Amsco Dipper digging trap rock for loading on trucks.

Right: Amsco 2½ yd. dipper, used on P. & H. 955 shovel.



Left: Amsco 2½ yd. dipper equipped with Amsco Simplex 2-Part Teeth, used for rock digging and loading at quarry.

Right: Special pin lock assures positive locking of reversible tip on Amsco Simplex 2-Part Teeth.



More proof that...

AMSCO HELPS YOU MOVE MORE TONS PER DOLLAR

Read about the actual experience of a large New England quarry with Amsco Dippers and Simplex 2-Part Teeth*

"WE HAVEN'T WORN OUT AN AMSCO DIPPER IN 5 YEARS"

This, in the words of the quarry superintendent, sums up his experience with Amsco Manganese Steel Dippers. It's rugged work, all in rock, as you see from the pictures at the left. Shovel and dipper are used to load trap rock onto trucks for transportation to the crushing plant.

The Amsco Dipper was installed because the superintendent had used them before, and knew their reputation for long life under tough digging conditions. Experience is proving him right . . . again.

SIMPLEX TEETH HANDLE 25,000 YDS. OF ROCK BEFORE REPLACEMENT

At this same quarry, Amsco Simplex 2-Part Teeth are giving 120 hours' service... handling 25,000 to 30,000 yards of rock... before replacement is necessary. That's considerably longer service than has been obtained from competitive 2-part teeth, the quarry superintendent states.

Not only is the wear-life of these teeth exceptional, but operators like the ease of replacement, and the fact that the tips stay on without trouble.

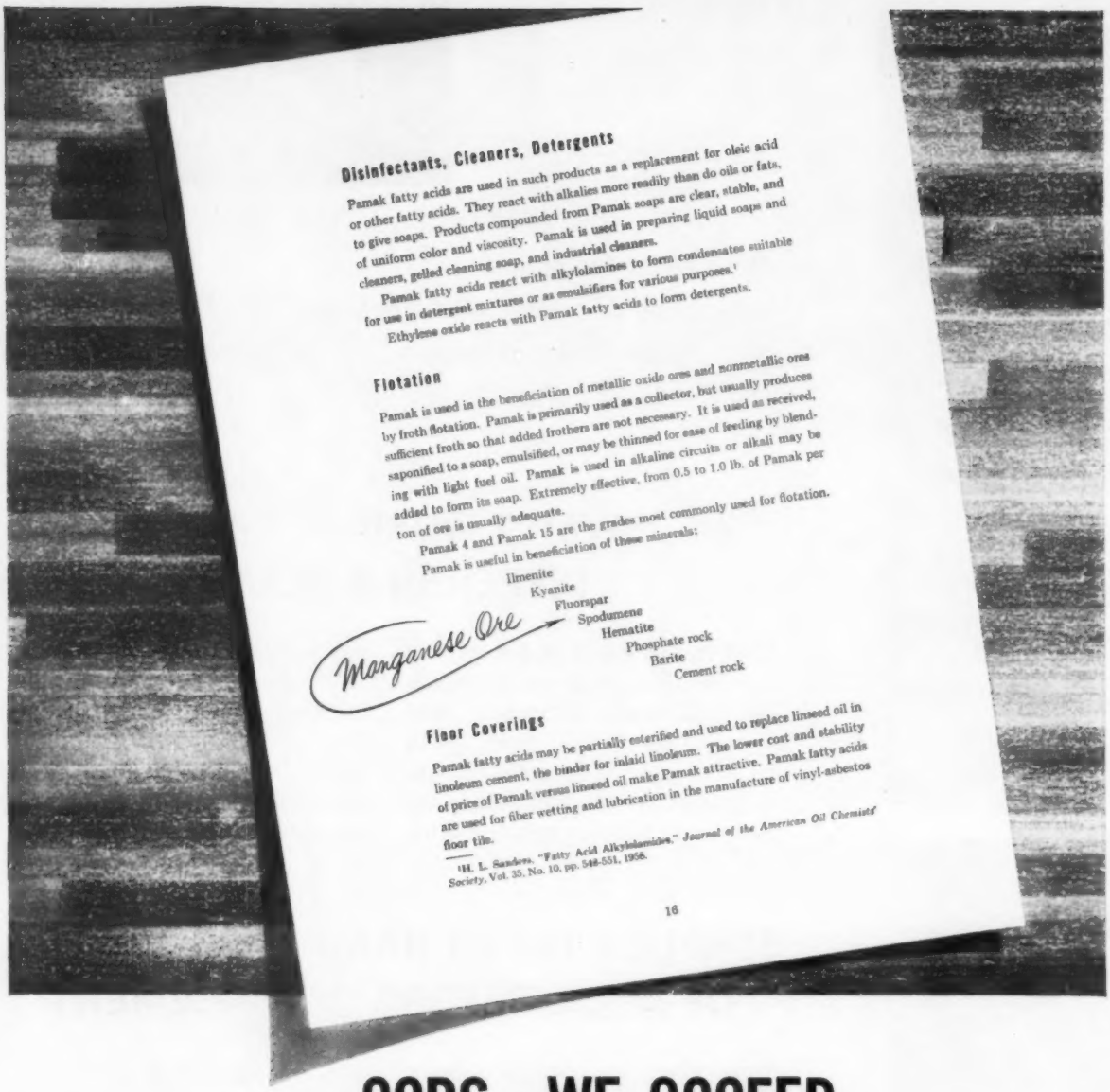
For further information on Amsco Dippers or Simplex 2-Part Teeth, see your power shovel equipment dealer, or write to Amsco for technical bulletins showing sizes, types and application data. *Patent No. 2,904,906

AMERICAN Brake Shoe COMPANY

AMSCO

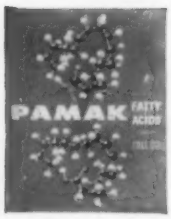
American Manganese Steel Division • Chicago Heights, Ill.

Other plants in: Denver • Los Angeles • New Castle, Dela. • Oakland, California • St. Louis
In Canada: Joliette Steel and Manitoba Steel Foundry Divisions


Disinfectants, Cleaners, Detergents
Pamak fatty acids are used in such products as a replacement for oleic acid or other fatty acids. They react with alkalies more readily than do oils or fats, to give soaps. Products compounded from Pamak soaps are clear, stable, and of uniform color and viscosity. Pamak is used in preparing liquid soaps and cleaners, gelled cleaning soap, and industrial cleaners.
Pamak fatty acids react with alkylolamines to form condensates suitable for use in detergent mixtures or as emulsifiers for various purposes.[1]
Ethylene oxide reacts with Pamak fatty acids to form detergents.
Flotation
Pamak is used in the beneficiation of metallic oxide ores and nonmetallic ores by froth flotation. Pamak is primarily used as a collector, but usually produces sufficient froth so that added frothers are not necessary. It is used as received, saponified to a soap, emulsified, or may be thinned for ease of feeding by blending with light fuel oil. Pamak is used in alkaline circuits or alkali may be added to form its soap. Extremely effective, from 0.5 to 1.0 lb. of Pamak per ton of ore is usually adequate.
Pamak 4 and Pamak 15 are the grades most commonly used for flotation.
Pamak is useful in beneficiation of these minerals:
Manganese Ore
Ilmenite
Kyanite
Fluorspar
Spodumene
Hematite
Phosphate rock
Barite
Cement rock
Floor Coverings
Pamak fatty acids may be partially esterified and used to replace linseed oil in linoleum cement, the binder for inlaid linoleum. The lower cost and stability of price of Pamak versus linseed oil make Pamak attractive. Pamak fatty acids are used for fiber wetting and lubrication in the manufacture of vinyl-asbestos floor tile.
[1] H. L. Sanders, "Fatty Acid Alkylolamides," Journal of the American Oil Chemists' Society, Vol. 35, No. 10, pp. 548-551, 1958.
16

OOPS—WE GOOFED

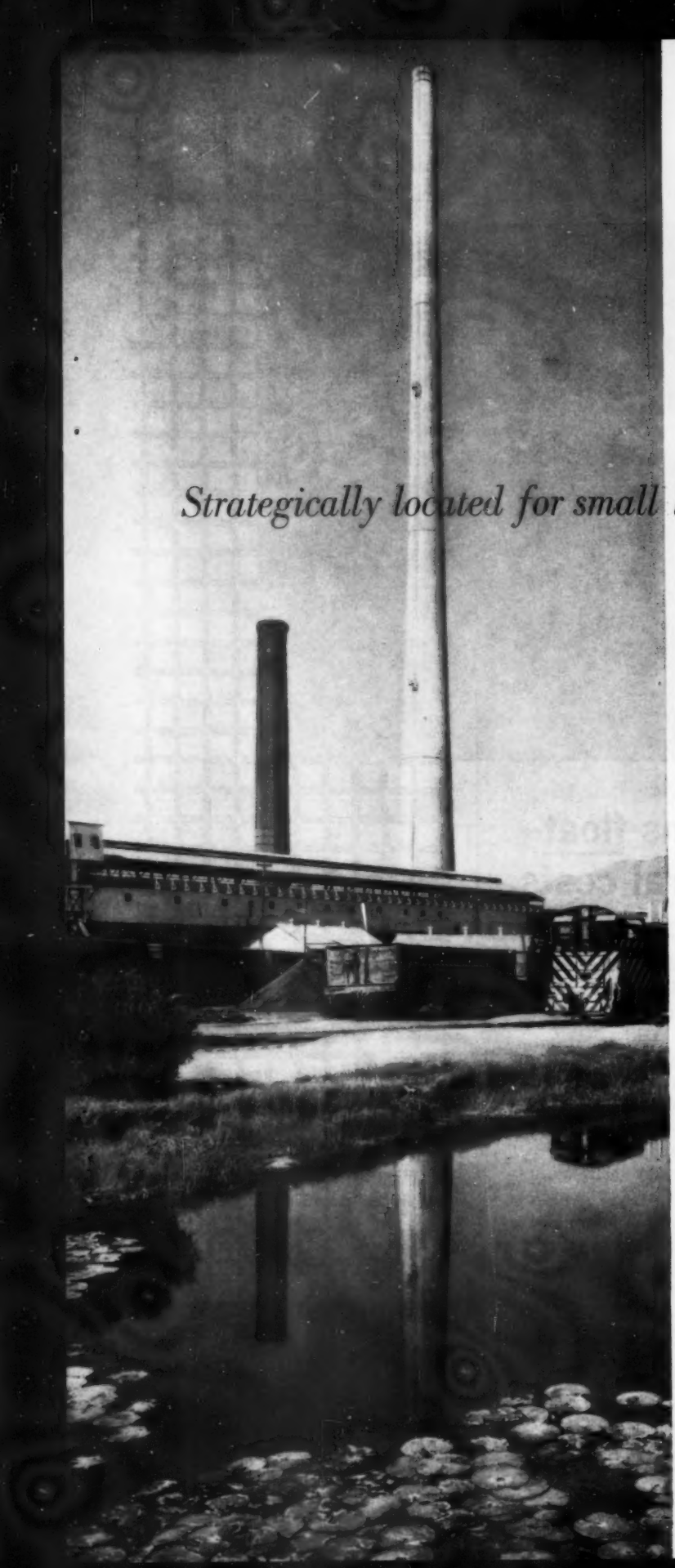
PAMAK® IS IDEAL FOR MANGANESE ORE, TOO



We can't even blame it on a copyreader, but when we printed our new booklet on Pamak, Hercules fatty acids from tall oil, we unintentionally omitted manganese ore from the list of materials where Pamak is exceptionally useful as a flotation agent. But we have *not* omitted our thorough research and technical service, and the high quality that consistently marks our product. If you already have your copy of this booklet, we hope you'll remember that manganese belongs. If you haven't received a copy, you'll certainly want one for your files. A postcard to Hercules will bring you your copy.

Industrial Chemicals Division
Paper Makers Chemical Department
HERCULES POWDER COMPANY
INCORPORATED
900 Market Street, Wilmington 99, Delaware

PT60-1



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buying, smelting, and
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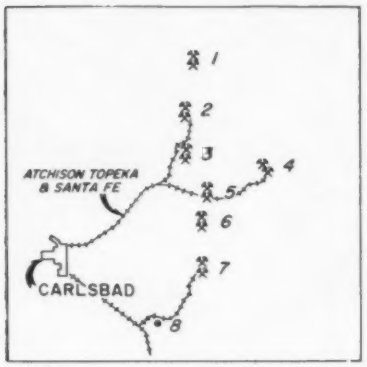
Duval Sulphur Developing New Potash Mine

Duval Sulphur and Potash Company has awarded a letter of intent to Winston Bros. Company of Minneapolis, Minnesota to sink two circular shafts to develop its new north potash mine in the Carlsbad Basin of New Mexico. Shafts will be round, concrete lined, and sunk to a depth of about 1,000 feet. All ore will be hoisted through the larger shaft.



Location of the new mine is shown by No. 1 on the adjoining map. All other producing potash companies in the Basin are also shown on this map. No. 2 is the Southwest Potash Company. No. 3 is Potash Company of America; No. 4 is National Potash Company; No. 5 is the location of Duval's present mine and flotation mill; No. 6 is United States Potash Company; and No. 7 is the International Minerals and Chemical Corporation. No. 8 is the mill of U. S. Potash. Farm Chemical Resources Development Corporation has completed a deep shaft east of Artesia but no mining has been done.

The new Duval mine will be developed to give the firm two sources of sylvite ore (KCL) and will open up reserves for mining which have been developed by surface drilling. Duval considers this to be an additional and separate ore body from that now being mined. From a mining and metallurgical standpoint ore from the two deposits is comparable so that no major mining changes or mill expansion will be needed. The Atchison Topeka and Santa Fe is extending a railroad to the new mine over which ore will be hauled to Duval's existing mill. No flowsheet changes will be needed. However, a blending plant will be installed to mix the two ores.

No Longer Need Zinc Curtailment, Says Lead-Zinc Study Group

The International Lead-Zinc Study Group announced in Geneva, Switzerland early in February that short term demand was so good for zinc that there was no need to continue the voluntary curtailment in production on a world wide basis. The group, with representatives of both government and the mining industry from all principal lead-zinc producing nations, met under auspices of the United Nations Lead-Zinc Committee.

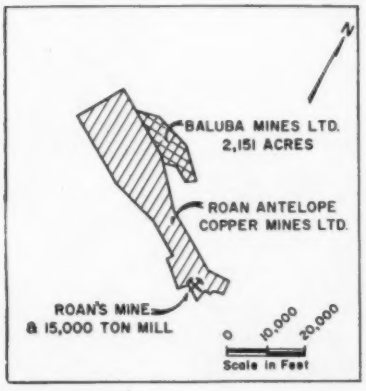
In May 1959 this same group met in New York, New York and decided to cut mine output in line with demand for both metals. This program called for voluntary reduction of 104,000 annual metric tons of zinc output and 90,000 of lead on a world basis.

Zinc consumption during the last part of 1959 was far ahead of the Group's estimate, so that for 1959 output and demand were generally in balance. For 1960 the prediction is for an increased consumption of 75,000 metric tons so that additional production was needed to prevent further declines in stocks. Increased demand for zinc raised price from 11.00 cents in May to 13.00 cents in January 1960.

With lead production for the first nine months of this year estimated at 50,000 metric tons over consumption it is desirable to continue the adjustment in supply the group recommended.

Just after the Geneva meeting, Secretary of the Interior, Fred Seaton, announced in Washington, D.C. that the existing lead and zinc quotas should be continued "at least beyond 1960." He claimed that domestic lead and zinc industries were making a slow comeback under the quota.

Study Mining of Baluba Copper-Cobalt with Roan Antelope



Development and mining of the Baluba copper-cobalt ore body in Northern Rhodesia is under consideration. Location of Baluba Mines Ltd.'s concession and the adjoining Roan Antelope Copper Mines Ltd. are shown on map. Studies are under way for integrating mining with Roan Antelope as both companies are part of the Rhodesian Selection Trust Ltd. group.

Undeveloped but drilled ore reserves at Baluba have been reported as 112,000,000 tons assaying 2.41 percent copper and 0.16 percent cobalt. Drilling in the last several years has indicated a greater strike length of the ore body as well as extensions in depth. The 1953 reserves were 70,000,000 tons assaying 2.68 percent copper and 0.18 percent cobalt. This is largest undeveloped Free World cobalt reserve.

In last fiscal year Roan Antelope mined 5,500,000 tons of 1.97 percent ore and produced 80,932 long tons of copper. It also celebrated mining of its 100,000,000th ton of ore. Reserves are reported as 95,560,000 tons of 3.05 percent copper. American Metal Climax, Inc. owns 50.61 percent of Rhodesian Selection Trust.

Southern Pacific's Geologists Find . . . .

By Lawrence B. Wright

Southern Pacific Company, in a joint-venture with Mineral Materials Company during the last two years, has indicated eight major deposits of concentrating grade magnetite in the Buena Vista area of the Mineral Lake mining district, southeast of Lovelock, Nevada.

Geological mapping, geophysical prospecting, and diamond drilling by the Southern Pacific geological staff has indicated low-grade disseminated extensions of high-grade direct shipping ore, as well as unknown deposits. The latter either had limited outcrops or were completely buried by alluvium. Chances for developing several additional and similar grade deposits by diamond drilling are believed to be excellent.

Metallurgical testing of diamond drill cores has proven the material to be magnetically concentratable, at a fairly coarse grind, to produce a 65 to 67 percent iron concentrate.

Southern Pacific Company engineers are evaluating drill results, metallurgical tests, possible markets, and other engineering and financial problems to determine how and when to bring these deposits into commercial production.

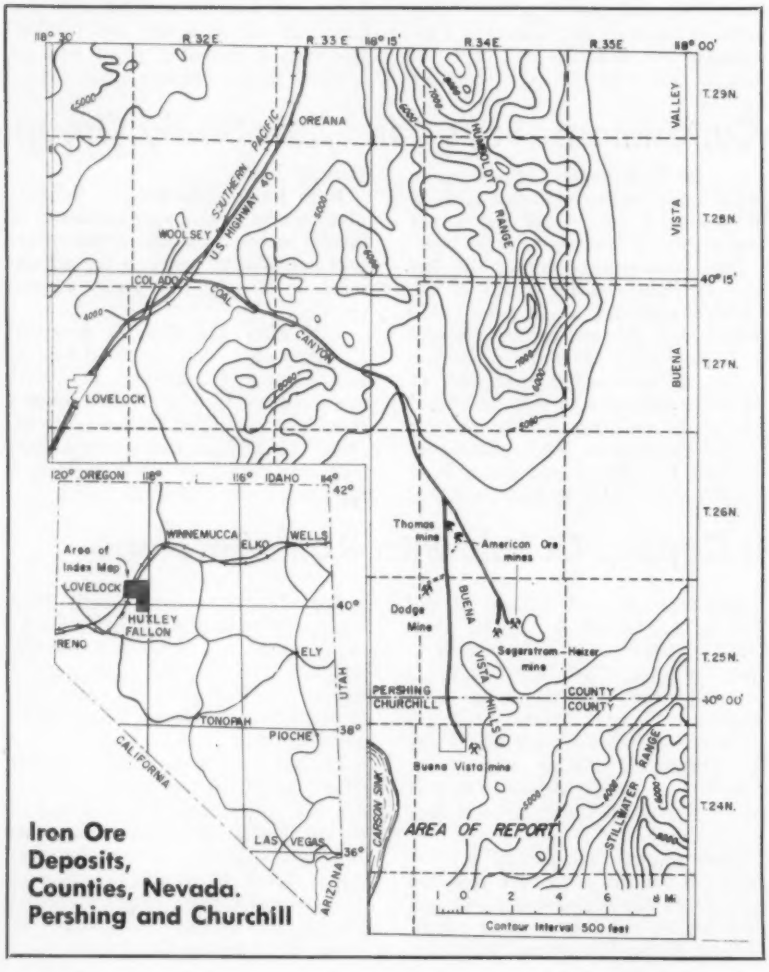
Southern Pacific's detailed mineral survey program started close study of the district in 1955, although company geologists had made reports on the district as early as 1902.

The district had been an important western ore producer from shallow workings since the 1880's, with total production of selected high-grade ore totalling 1,768,000 tons of 54 percent or higher iron ore by the end of 1958.

The detailed survey soon developed information which indicated that large volumes of material containing a substantial amount of iron, mostly in the form of magnetite, were being rejected because of low iron content, and smaller amounts because of high phosphorus content. Magnetic anomalies, developed by geophysical prospecting in 1957, indicated that large bodies which might be mined and beneficiated to provide an improved product, existed both in known and new areas.

Detailed geophysical work and a drilling program of 30 diamond drill holes in 1957 on a railroad company section in the southern part of the district, outlined a previously unknown ore body. The work was completed from April 1957 to February 1958.

Proof by Southern Pacific of substantial tonnages of disseminated type ore resulted in a joint exploration venture with Mineral Materials Company to investigate and drill on their adjacent lands, and other railroad company lands in this district. Mineral Materials' property was believed to contain about 2,500,000 tons of ore at that time; a large proportion was of the massive shipping type.



Iron Ore Deposits, Counties, Nevada. Pershing and Churchill

Description of District

As presently known, the Buena Vista iron ore occurrences in Pershing and Churchill Counties are shown on location map.

Elevation varies from 4,100 to 5,100 feet along a low, broken series of (Buena Vista) hills lying between the Stillwater and Humboldt ranges. In and adjacent to the hills are the iron-bearing deposits. To the west and paralleling the hills is a flat alluvium-covered valley, the north part of the Carson Sink.

Geology of District

The accompanying geologic map is compiled from Southern Pacific's mineral survey reconnaissance maps, 1955 to 1958, with some additions. The map shows metavolcanic rocks intruded by diorite and albitite, and a later series of intermediate to basic dikes. Scapolitization is indicated separately on the map in the Buena Vista mine area, but is not separately indicated where occurring elsewhere in the area. Scapolitization is widespread and is not a local guide to ore. Iron mineralization and individual important deposits are shown. Tertiary rocks, all post-mineral, are not segregated

Mr. Wright is chief of geological exploration for the Southern Pacific Company. This article was prepared from reports of the company's geological staff.

132,000,000 Tons Low Grade Iron Ore

in this presentation. Major faults are shown.

Iron mineralization, predominantly magnetite, occurs in massive vein-like blocks whose shape and individual trends were largely determined by premineral fault mosaics with little pattern, and disseminated magnetite occurring throughout large masses of metavolcanics and occasionally in albitite. Certain phases of diorite in the central part of district contain bands (¼ to 3 inches) of magnetite in sheeted zones. A considerable proportion of intermediate grade mineralization occurs in metavolcanic breccia, particularly in the Buena Vista mine area, West ore body.

Hematite is more abundant in the northern part of the district, but even there magnetite is dominant.

Sphene contributes minor titania in the southern part of the area. Vanadium pentoxide averaging 0.4 percent is present in magnetite concentrates and is believed to be derived from the unidentified vanadomagnetite mineral coulsonite.

Ore deposits of the district occur in both metavolcanics and diorite but predominantly in metavolcanic rock, scapolitized with an abundant development of hornblende near contacts with intrusive diorite, also scapolitized.

In the central part of the district (Sec. 15-25-34), chloritized diorite is the principal host in sharp contrast to overlying medium-textured diorite with fewer mafics. At the Buena Vista mine is a large mass of throughly scapolitized diorite. It has the form and character of a breccia pipe with large inclusions of metavolcanic rock, containing the district's most important known source of iron ore so far developed, localized in a mesh of premineral faults. Some post mineral faulting has occurred.

Metallurgical Tests

Warren L. Howes, consulting metallurgist of Menlo Park, California, was retained to direct test work contracted to the University of Minnesota's Mines Experimental Station at Minneapolis, and to the Utah Construction and Mining Company's metallurgical laboratory at Palo Alto, California.

Davis Tube tests were run on all drill cores containing plus-15-percent iron. In addition, ore block composite samples were made from drill cores to represent individual blocks selected by depth and strike location which averaged 28 percent or more iron.

The results of this extensive test work indicate that a conventional taconite magnetic separation flow sheet employing dry cobbing of minus-2½-inch feed, wet cobbing the concentrate at minus-10-mesh, roughing the wet concentrate at minus-150-mesh, and then cleaning this concentrate without regrinding, produces a final 65 to 67 percent iron concentrate containing 3.0 to 5.0 percent combined alumina and silica. Other trace elements and components are well under acceptable limits for natural ores. Over-all recovery of iron in the tests averaged about 85 percent.

Acknowledgements:

The following Southern Pacific Company personnel have contributed directly to the field mapping and detailed geophysical and engineering work in the Buena Vista District leading to the expansion of iron ore reserves: W. C. McCulloch, chief geologist; L. B. Wright, chief of exploration; G. A. Kiersch, assistant chief of exploration; Keith Papke, geologist-mining engineer (group leader); R. E. Shepherd, Andrew Cunningham, John Sharp, Max Schafer, James Cooksley, and Don Metzler, field geologists; R. C. Resler, geophysicist; E. P. Sheppard, geophysicist (group leader); R. R. Dorsey, and R. E. Willson, geologists; and H. Bonham, geologist (group leaded).

Other members of the staff who have mapped in the area on a reconnaissance basis are Warren Coonrad, and Edward A. Danehy, geologists; Ralph Anctil, Ray Laird, and E. Kojan, field geologists.

Melvin Redhead, Mineral Materials mining engineer, has contributed from his records and knowledge.

Turn page for drilling and sampling procedures.

How Southern Pacific Maps 14,500,000 Acres

The Buena Vista iron ore project is only one of the many natural resource surveys being made by the railroad company's Land Department, of which Louis Frandsen is manager. William G. McCullough is chief geologist; and Lawrence B. Wright, chief of exploration.

The program, using all of the latest exploratory techniques, was begun in January 1955, has for its objective the classification of some 4,300,000 acres of owned lands as to mineral value—metallic and non-metallic. In order to accomplish this, a field staff of 18 will eventually cover about 14,500,000 acres, owing to the checker-board pattern of ownership. The areas to be covered lay in California, Nevada, and western Utah.

This is the largest comprehensive geological mapping and mineral resource inventory ever undertaken by a private company in the United States.

Field studies have been undertaken to conform to the best climatic conditions. Crews normally work in southern California during the winter months and then move to Nevada and northern California during the summers. However, one crew is working through the present winter in Nevada. California crews during the winter of 1959-1960 have been busy from headquarters in Needles, Barstow, and Coalinga.

Mapping in Nevada has progressed eastwards from Fernley to Battle Mountain. Crews are scheduled to return to northern California this summer where mapping will be completed this year. The field force is divided into two groups. The 12-man reconnaissance geological mapping group is under the direction of Dr. George A. Kiersch, assistant chief of exploration. The six-man special projects group, which includes a well-equipped geophysical team, does the detailed work on mineral occurrences believed to have some promise.

The office staff of 10, including six draftsmen, prepare background data for field geologists and complete geological maps. Reconnaissance maps are on a scale of 1:24,000, and each covers two townships. Special project maps are at scales selected to fit the problem being studied. Aerial photography is used throughout.

At the end of 1959, Southern Pacific's president, D. J. Russell announced that the "mapping phase of the survey is now about 65 percent complete and it's going forward at the rate of 400 square miles per month, with a completion target of mid-1961. The more detailed examination and exploration of promising areas is underway simultaneously but will extend beyond that date."

Sludge Sampling Done at Drill, Core Sampling and Logging . . .

DRILLING THROUGH ALLUVIUM at Iron Point ore body. Buena Vista mine in right background; waste dumps at left.

Table No. I

Diamond Drill Footage and Recovery by Hole Types at Southern Pacific Company's Buena Vista Iron Ore Exploration Project

Hole Classification	Number of Holes	Feet Drilled	Drill Shifts	Average Feet Per Shift	Average Core Recovery Percent
All holes	62	26,712.1	1,574	17.0	65.8
Inclined holes	14	8,773.5	702	12.5	66.8
Vertical holes	48	17,938.6	872	20.6	65.3
East ore body	11	4,677.2	212	22.1	84.9
West ore body	29	12,009.2	706	17.0	58.0
5-8 ore body	6	2,067.2	99	20.9	79.1

A sampler, employed by Southern Pacific, was present at the drill during coring operations. He was responsible for measurements of depth, keeping of drill records, and collection and handling of core and sludge samples. All sampling was done under the supervision of Donald Metzler, field geologist for Southern Pacific.

Sludge samples were caught in steel boxes, one foot square and six feet long. The boxes were fitted with three baffles that allowed water to pass through several rows of holes near the water surface. Any accumulated drilling grease was removed before the sample was decanted and collected.

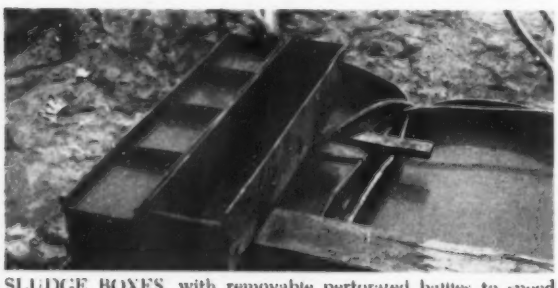
Sludge samples were taken at 10-foot intervals, in even intervals. When core recovery for the 10-foot interval was over 60 percent, the sludge sample was discarded. The remaining sludge samples were dried over a low wood fire during cold weather and by the sun during warm weather), pulverized to break up lumps, and split into two samples. One portion was assayed for total iron by Curtis & Tompkins, Ltd. at its Lovelock laboratory; a pulp sample was retained from this material. The other split was stored in a plastic bag for possible future use.

The core barrel was pulled and emptied whenever required by good drilling practice. Core was caught in steel troughs, washed, and transferred to cardboard boxes with 10 foot capacity. Core was picked up daily and stored in the field laboratory in preparation for logging.

Most of the core logging was done by R. E. Shepherd, field geologist for Southern Pacific. The core was measured and wooden blocks were inserted at 10-foot intervals, corresponding to the starting and ending points for the sludge samples. The core for each 10-foot interval was then measured and recovery calculated. Geologic logging, partially controlled by these 10-foot intervals, was done on a combination graphic and descriptive log. Rock types, alteration, structural features, and other pertinent data

Diamond Drilling Averages 17.0 Feet Per Drill Shift, Core Recovery

WEST ORE BODY CORE shows intense fracturing and brecciation. Note the fractures in sections just above the note book.



SLUDGE BOXES, with removable perforated baffles to speed setting, designed by a Southern Pacific geologist on this job.

Under joint-venture exploration, detailed geology and geophysical work was followed by 62 diamond drill holes (48 vertical, 14 inclined) located in five separate ore bodies within a one-mile radius. Of the five ore bodies tested, four had not been delimited except by geophysical work.

Drilling was started on January 23, 1958 and completed by August 30, 1958. Six drills were operated throughout the program, working a total of 60 shifts per week. Drilling was done under contract by Boyles Brothers Drilling Company of Salt Lake City.

Table No. I shows some statistics concerning footage, progress, and core recovery.

Chicago Pneumatic No. 8 drills were found to be the most satisfactory for this type of deposit and were used for the majority of the holes. Other types used were the C. P. No. 12, C. P. No. 15, Sullivan No. 22, and Christenson X-Ray. Truck-mounted rigs were used for most of the vertical holes. Both dismounted truck drills and skid-mounted drills were used for the inclined holes, using timber tripods for hoisting.

Core barrels used were the series "C-2," double tube, swivel (available only in BX wireline size), the series "D-2," double tube, swivel (available in BX and AX sizes) and the rigid type, double tube (available in all sizes). In general, holes were collared with NC size bit to an average depth of eight feet; continued with NX size to about 50 feet; and finished with BX or BX wireless size. In some cases, it was necessary to reduce to AX size to complete a hole. BX

Done in Field Laboratory To Prepare Seven Separate Samples

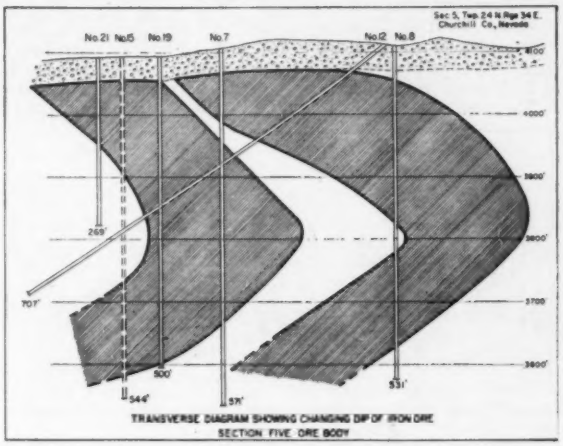
were recorded. An estimate of iron content was made for each 10-foot interval; this estimate was for iron present in magnetite and locally in hematite, but not in chlorite, hornblende, or other iron-bearing minerals. Small character samples were taken for each 10-foot inteval, or at closer spacing if warranted.

The core from all holes was split with a Longyear-type splitter in selected intervals ranging from 20 to 100 feet, and averaging about 40 feet. Factors influencing division of core samples were as follows: 1. estimated percentage of iron present as magnetite or hematite; 2. core recovery; 3. size of core; and 4. geology. Approximately 580 samples were split and processed.

One-half of the core was retained in the original boxes and stored for possible future use. The other one-half was crushed, pulverized, and split in a series of steps with an end product of an 80-gram sample and duplicate of minus-150-mesh size. Most of these samples were sent to the Mining Experiment Station at the University of Minnesota for analysis and test work. A few low-grade samples were sent to Curtis & Tompkins and assayed for total iron. All reject material from the above process was bagged and saved.

The following is an inventory of samples retained from the drilling program:

1. One-half of the split core, stored in 10-foot core boxes.
2. Core character samples from all holes.
3. Assay pulps of sludge samples from intervals where core recovery was under 60 percent.
4. Duplicate sludge samples from intervals where core recovery was under 60 percent.
5. Minus-¼-inch material split out from the crushed core.
6. Minus-8-mesh material split from the pulverized core.
7. An 80-gram duplicate, minus-150-mesh size, of each sample sent to the University of Minnesota.



TRANSVERSE DIAGRAM SHOWING CHANGING DIP OF IRON ORE
SECTION FIVE ORE BODY

Table No. II

Footage Drilled and Core Recovery by Hole Sizes at Southern Pacific Company's Buena Vista Iron Ore Exploration Project

Hole Size	*Total Footage*	*Average Core Recovery in Cored Ground, Percent*
NC	499.2	20
NX	2,697.3	29
BX	6,963.7	63
BX (wireline)	11,391.1	81
AX	5,160.8	56

Averages 65.8 Percent, BX Wireline Highest at 81.0 Percent

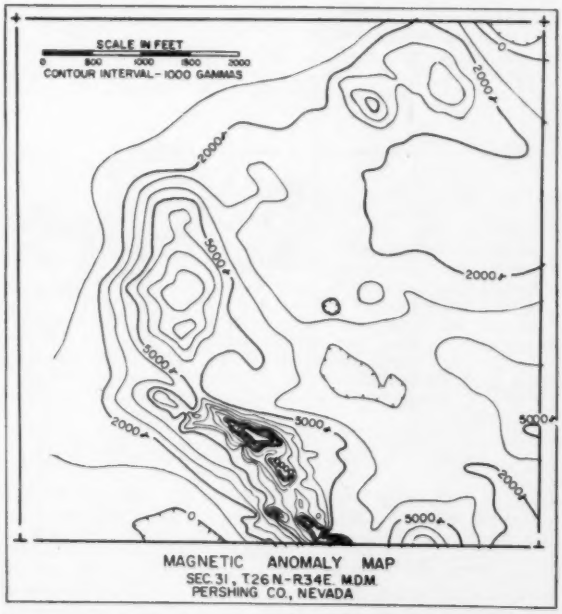
wireline equipment was used whenever practicable. Footage drilled and core recovery for the various hole sizes are shown in Table No. II.

The low core recoveries for NC and NX sizes were due to weathered and broken ground in the upper portions of the holes. Recovery with BX wireline may be slightly less favorable than the tabulation suggests because of a tendency to use wireline equipment in better coring ground.

Drilling mud was used to start holes in gravel or broken rock but was eliminated from the circuit before collection of sludge samples was commenced. Cotton-seed, bran, perlite, and other hole conditioners generally were not employed; where used, an effort was made to protect the sludge sample against contamination. In a few cases it was necessary to use mud during coring operations to improve core recovery and sludge samples were not taken.

Water for drilling was obtained from wells and springs. Three water truck shifts were necessary each day to keep the drills supplied.

Holes were cemented whenever necessary to obtain high water return and prevent caving. Cal-seal and Lumnite cements proved most effective in this ground, casting plaster was used occasionally. Portland cement was seldom used because of slow setting time and poor results. Total paid cementing time was 1,270 hours, or 0.048 hour per foot of hole. The inclined holes, which made up 32.8 percent of the total drilling, accounted for about 67 percent of the cementing time.



MAGNETIC ANOMALY MAP
SEC. 31, T26N-R34E MDM
PERSHING CO., NEVADA

Turn page for location and full details of major ore bodies

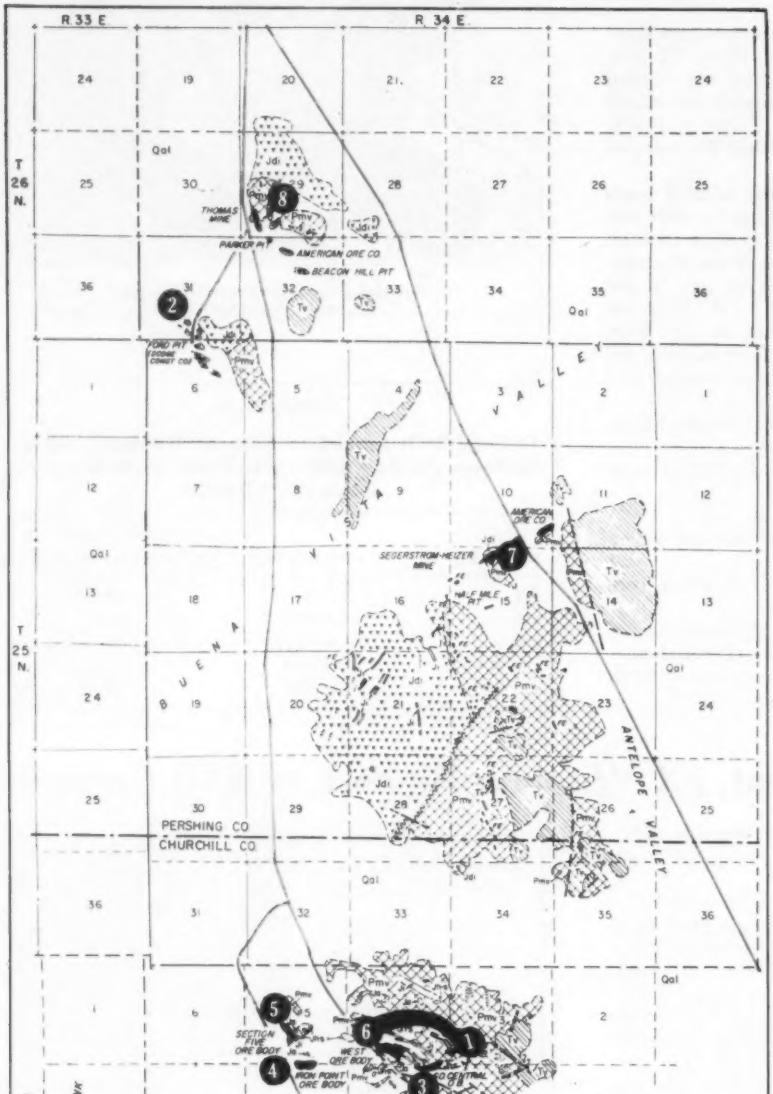
These Eight Principal Deposits Have Been Explored . . . . .

1. THE EAST ORE BODY, *Sections 3 and 4, T. 24 N., R. 34 E.*

This ore body is mainly of the disseminated type with scattered small lenses of high grade materials.

The anomalous area is 1,200 by 500 feet and was penetrated by 11 drill holes on a rough grid, 700 by 375 feet, with ore extensions giving a safe total length of at least 1,000 feet. The long axis of ore deposition trends northeast as opposed to the northwest trend of several dikes throughout the ore zone and beyond.

This ore body is at the highest elevation of any tested in the district, with outcrops at 4,900 feet elevation in contrast to the 3,200-foot level, a total vertical differential of 1,580 feet, indicating that ore might be expected at this depth under the East body.



MAP SHOWING GEOLOGIC RELATIONS
KNOWN IRON DEPOSITS
CHURCHILL AND PERSHING CO'S, NEVADA
COMPILED BY L.B. WRIGHT
DRAFTED BY S.F. MORGAN
JULY 1958
SCALE IN FEET

2. SECTION 31 ORE BODIES, *Section 31, T. 26 N., R. 34 E.*

Ore bodies are exposed in two pits excavated by Dodge Construction Company under lease from Southern Pacific. These are vein-like massive ores and vary from a few feet to 50 feet in thickness. They have been mined for a length of 300 feet in Section 31, for 500 feet in adjoining Section 6, where Dodge Construction has produced over 500,000 tons of plus-60-percent ore under lease from Ford Motor Company.

Geophysical work indicated a continuation of the massive ore zone to the northwest for 3,400 feet in Section 31 in an anomaly 800 feet wide. The northern portion of the anomaly, because of evenly-distributed magnetic values and general pattern, is believed to represent a large body of disseminated magnetite. This area has not been drilled.

3. SOUTH CENTRAL, *Sections 4 and 9, T. 24 N., R. 34 E.*

Drilling on this ore body was based entirely on geophysical results. Six inclined and seven vertical holes were drilled to an average depth of 380 feet; the deepest reaching a vertical depth of 500 feet, still in medium-grade iron material. The area drilled in irregular pattern is close to 400 by 1,700 feet. This does not include a large untested anomalous area (Central).

The ore is mostly of the disseminated type in metavolcanic rock.

4. IRON POINT AND SOUTHWEST, *Sections 5 and 8, T. 24 N., R. 4 E.*

The Iron Point ore lies entirely beneath Lahontan terrace gravels, except for four small outcrops in the northern portion, all of which are well mineralized. The average depth of cover is 25 feet with a maximum of 78 feet over a bedrock drainage channel.

The main anomalous area above the 5,000 gamma isogonic contour is 1,400 feet long (east-west) by 700 feet average width. This occurrence was first roughly outlined by United Geophysical Company in 1951, and that portion in Section 8 on the Iron Point claims was under option by that company who put one short drill hole through 11 feet of overburden to a depth of 67 feet in rock-bearing disseminated magnetite. No assays were made because the search was for massive ore. A second hole was drilled to 35 feet and stopped in overburden.

Dodge Construction Company, in a later similar attempt, drilled two holes to 75 and 105 feet, encountering disseminated ore in a search for massive ore.

The area of the anomaly lying in Section 8 and covered by the Iron Point claims was optioned to Mineral Materials by Nevada Iron Ore Company in May 1958. A 50 percent interest in this option

. . . With Many Other Outcrops and Anomalies To Be Tested

is now held by Southern Pacific Company.

The joint venture drilling in August 1958 was limited to six widely-spaced holes so placed as to test the anomaly as a whole. This followed a program of closely spaced magnetometer observations which served to outline and indicate the potential of the anomaly.

Because of the uniformity of results in all drill holes and the character of the anomaly lying between two of its gram on this area has closely delimited the ore potential.

An alluvium-covered anomaly (Southwest) was outlined by the Southern Pacific Company's geophysical crew in June 1958. It lies within the Iron Point claim group and is 1,000 feet southwest of the main Iron Point anomaly above described. It is 900 by 350 feet within the 5,000 gamma contour.

5. SECTION FIVE ORE BODY, *Section 5, T. 35 N., R. 35 E.*

Geophysical work by Southern Pacific, resulting in a 900-foot-long magnetic and gravity anomaly, commenced in April 1957. The long northwest axis of this gravel covered magnetic and gravity "high" parallels a smaller anomaly 300 feet to the east on lode claims of Mineral Materials, previously outlined by E. L. Stephenson for its account in 1952. United Geophysical did some work in this area in 1954 but ran north-south lines on ¼-mile spacing, thus failing to discover the anomaly, it is believed the drilling protraverses.

The size of the anomaly and particularly the high (off-scale) magnetic readings in the central portion prompted the drilling program by Southern Pacific between June 1957 and February 1958. Thirty holes were drilled on a grid pattern of 100-foot spacing, for the most part. The total footage was 14,286.6. Average depth drilled was 483 feet. The deepest hole, No. 5, on the east central part of the anomaly, was drilled to 779.8 feet. Medium-grade, iron-bearing material at the bottom indicated continued mineralization to at least this depth.

A small, inconspicuous outcropping at the south end of the anomalous area contains some magnetite but does not suggest a sizable body.

The central and richest iron-bearing portion of the ore mass is composed of veined, clustered, and disseminated magnetite in mildly brecciated albitite, diorite, and possibly some metavolcanic rock. Outward from the central core and to the northeast the magnetite occurs less in patches and veinlets and is more regularly disseminated. The southwest ore limit is, in contrast, quite sharply defined.

The long dimension of ore is N. 75° W., dipping northeast to about 300 feet at which depth the inclination reverses to the southwest along a flat axial plane extending parallel to the long dimension of ore from south to north, as shown in transverse diagram.

The 5,000 gamma contour bounding the main deposit does not close to the east until encompassing the smaller, plus-10,000-gamma, above-mentioned anomaly on the Wyoming and Rover claims. There is a small outcrop of massive magnetite on the Rover claim. This eastern part of the anomalous area has been tested with a few shallow wagon drill holes which are not definitive of grade or tonnage potential.

6. WEST ORE BODY, *Section 4, T. 24 N., R. 34 E.*

Located on lode claims of Mineral Materials, this ore body has proven to be at least 2,000 feet long, averages at least 450 feet wide, and has been penetrated by drilling during this program to a depth of 500 feet.

These outcrops were examined by Southern Pacific Company's mining engineer, F. M. Anderson, in 1902, who reported on this and other occurrences in the district.

Since 1952, an estimated 1,500,000 tons of rock have been excavated of which the last 1,200,000 tons have been beneficiated in the dry magnetic cobbing plant of Mineral Materials, leaving some 950,000 tons of "waste" containing about 32 percent iron; material suitable for further beneficiation.

The West ore body is the largest thus far outlined in the district. It contains, in the western half, a large proportion of massive ore. This has provided ore for past intensive mining, resulting in a pit 400 by 200 by 60 feet deep.

A pre-mineral fault system determined the localization and trend of the massive ore blocks as well as the change to disseminated, lower-grade ore in the eastern portion where the host rocks are less shattered and brecciated.

Post-mineral faulting is present, but not particularly apparent in outcrop study. Its presence is best demonstrated when plotting drill hole ore intersections on transverse and horizontal structural sections.

Geophysical work included a closely spaced grid of magnetometer readings. Drilling confirmed a north inclination of ore as both walls dip about 53° northward on the west half. The term "wall" is used advisedly because the ore limits, except at the west end, are expressed in progressively fading mineralization which is oriented along definite northeasterly trending cut off grades on the north wall and less defined on the south side where the adjacent "Central" magnetic anomaly remains to be drilled.

There is a very interesting geological possibility that the north-dipping ore might be subjected to a similar structural reversal as found in the Section Five bodies. If true, the massive magnetite bodies would be found at some depth a short distance southwest of the present massive ore, and beneath a moderately high magnetic anomaly.

7. SECTION 15 ORE BODY, Segerstrom, *Section 15, T. 25 N., R. 34 E.*

This deposit, belonging to Southern Pacific, was described by F. M. Anderson in his district report of 1902. Since then, mainly from one open pit, some 680,000 tons averaging slightly above 60 percent iron have been mined and marketed by Charles Segerstrom, lessee. Most of this ore has been produced since 1942. From the pit, 1,310,000 tons have been excavated and 630,000 tons remain on dumps containing an average iron content of 27.5 percent.

Massive ore continues in depth to 500 feet as indicated by U. S. Bureau of Mines drilling in 1944 and 1945, during which at least one of six holes cored 24 feet of massive ore at a vertical depth of 500 feet below the original outcrop and some 350 feet below the bottom of the present pit.

South of and adjacent to the pit, but separated from massive ore by a zone of strong northeast faults, is a mass of "stringer" ore exposed in shallow trenches over a width of 150 feet. Magnetometer work during the present program outlined an anomaly in this vicinity above the 10,000 gamma contour, 1,000 by 400 feet. This remains to be explored by drilling.

These ore occurrences are localized along a zone of shearing and alteration trending N. 58° E. into the adjoining section. Along this zone, ore has been extracted from two limited, hematite-rich deposits in Section 10.

Ore bodies in Section 15 occur in diorite and metavolcanic rocks.

8. SECTION 29 ORE, *Thomas, Section 29, T. 26 N., R. 34 E.*

The deposits here are massive ores, largely magnetite but with some hematite, localized mostly in northerly trending bodies. The whole suite of veins and masses has an east-west long axis of some 4,000 feet across the south half of the section in metavolcanic rocks.

Ore has been produced by Southern Pacific lessees from three main pits and several smaller workings. The largest, the Park (Thomas) pit is 1,000 feet long with 850 feet of ore thinning from 80 feet (massive) to stringers at the north end. The pit has a maximum depth of 75 feet. In the other two pits to the east are a series of multiple occurrences with north-northeast strike and steep dips. Vein lengths to 500 feet and thicknesses to 50 feet are seen here.

One diamond drill hole was slanted under the eastermost of the three large pits but failed to cut comparable mineralization because of a possible northern rake.

Geophysical work is inconclusive as to disseminated ore. A small separate anomaly occurs near the southwest corner. Taken as a whole, this mineralized area of 4,000 by 1,000 feet may contain sufficient ore within the rock mass to constitute an additional reserve.

EPOXY RESINS . . .

Patch concrete, combat corrosion,

By Joe Jurneke

Concrete engineer at Climax Molybdenum Company, Climax, Colorado.

The Climax Molybdenum Company, a division of American Metal Climax, Inc., has been concerned with abrasion problems for many years. Constant investigation, field test programs, and metallurgical changes are a part of the daily routine.

Maintenance of the tailing disposal systems has been a long, repetitious, and expensive program. Some abrasion damage in the system has been so extensive that entire sections were replaced rather than repaired. Other problems confronting the mill department concerned maintenance of rubber-lined machinery, pipelines, and launders.

Engineers were assigned to field and laboratory testing to determine the practical uses for Epoxies. Tests were conducted for adhesion, peel-back strength, thermal shock, conductivity, waterproofing, acid and corrosion resistance, as a painting application, and ease of handling and applying. To date, 60 different types of Epoxies have been tested. From this number, four have been selected as versatile enough to meet all requirements as known at the present time. They are listed with their uses and application procedures in order as No. 1, No. 2, No. 3, and No. 4.

Epoxy No. 1—Best for concrete repair . . . . proves acid resistant

Laboratory and field tests proved this Epoxy No. 1 patchwork to be highly successful, both in concrete and wooden structures. To improve the wear life of the repair work, a metalized aggregate was used and found to be the most economical over a long period of exposure. The initial cost of the aggregate is high, yet wear life has increased four to five times beyond the normal life of the parent material. The metal aggregate serves another very important purpose—when mixed with proper proportions of Portland Type No. 1 cement and water it creates a fast, high heat, which cures the Epoxy bond in 1½ to 2 hours, decreasing the downtime of the system. This application is performed by using a two-part Epoxy—one part adhesive, the other a catalyst. The materials when combined can easily be wooden or concrete surface.

At 70° F. the Epoxy will cure and be ready for the patch application in 30 to 40 minutes. This time can be reduced to 15 minutes by applying a heat of 120° F. This Epoxy bonds wood and concrete.

This same Epoxy was successful as a paint application. When used as a paint, a color pigment can be added to the resin and catalyst. A special

Epoxy Resins are formulated plastics with

EPOXY RESINS have been termed plastic materials that become hard, infusible solids upon the addition of a hardening agent.

However, accurately speaking, there is really no such thing as an Epoxy resin. What is generally referred to as an Epoxy resin differs according to the type of basic resin employed, the hardening agent, and the additives used. What is generally referred to as an Epoxy resin is, more properly, a formulation of ingredients. The formulation selected depends on the use or application to which the Epoxy resins will be put. Thus, the cured formulated resin may have outstanding properties for a wide variety of uses, or have definite properties for specific uses.

PROPERTIES OF EPOXIES that make them especially valuable are: excellent adhesive action; high chemical, solvent, and thermal resistance; and low shrinkage on curing.

The word "Epoxy" is derived from the Greek prefix meaning over, or between, and the English suffix for oxygen. Thus, an Epoxy is an "oxygen between" compound and is postulated to contain the molecular grouping shown above.

This grouping is most commonly found in a number of different substances derived from petroleum products, such as ethylene oxide and its family of chemicals. Castor oil contains the Epoxy group formed by vegetable rather than mineral sources.

PRODUCTION OF EPOXIES: They are produced from a derivative of coal tar known as bisphenol-A, and from an intermediate product formed during the manufacture of synthetic glycerin. This is called epichlorohydrin.

By varying the concentration of bisphenol and epichlorohydrin around a standard formula the manufacturers produce a number of resins of different molecular lengths. Those with low bisphenol to epichlorohydrin ratios form shorter lighter molecules which are liquids. Those with higher ratios form longer and heavier molecules which are solids.

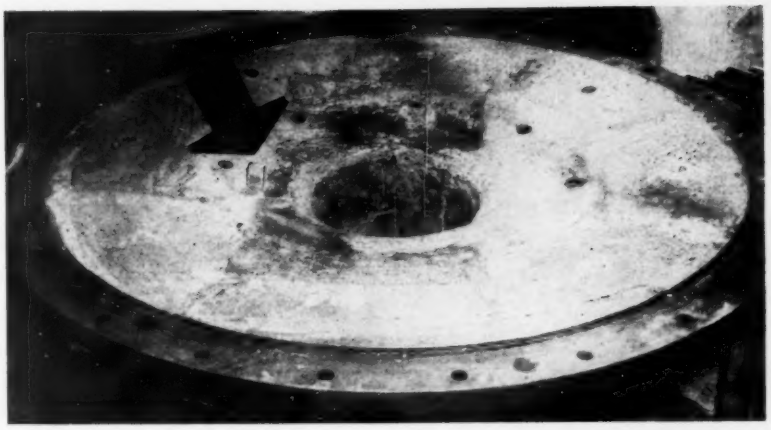
Many Epoxy resins molecules are thermoplastic. That is, they can be repeatedly softened by heat and hardened by cooling. Their value, however, lies mainly in the ease in which they can be changed into hard, tough, infusible solid or thermosetting material of high chemical and thermal resistance. This change is caused by certain hardening agents which begin a chain link action which "cures" the resins into commercially useable forms.

CURING usually generates considerable heat. This represents the chemical energy being liberated by the reaction. This heat raises the temperature of the hardening resin and increases the rate of cure. There is, however, a limiting temperature above which the curing process is degenerated and above which defects, such as cracking, occur. Therefore the proper selection of the type and amount of resin formulation and hardener is critical, as are the facilities to remove excess heat.

POT LIFE is the period between the addition of the hardener and the time at which the cure has proceeded so far that the resin is unworkable. It is a function of the type and amount of resin, hardener, and additives in the system.

rebuild parts

The first completed tests were for applications in the tailing disposal system. Prior to Epoxies, patch repair work was not successful. Troweled patches of concrete lifted due to the natural shrinkage of curing concrete, nailed wooden patches failed as soon as the nail heads were worn off, wear points in the angle and vertical penstock failed for the same reason the pipelines failed. All these wear points necessitated replacement rather than repair.



HIGH ADHESIVE STRENGTH of epoxy resin was used to bond metallized aggregate to pebble mill head; ¾-inch of epoxy was used to hold ¾-inch of hand troweled aggregate in place. Total cost $75.00. Cigarette lighter shows scale.

. . . . can be applied by brush or spray . . . . forms a strong bond

reducer is required when the application is made by spray. The manufacturer provides all necessary ingredients as a standard stock item with the exception of the color pigment. This he adds as ordered by the consumer. The pot life of this Epoxy after catalyst has been added is approximately one hour. As a paint application, the pot life is reduced to 40 minutes. The expansion and contraction characteristics of the Epoxy is comparable to that of mild steel. Tests were conducted in the laboratory, using a brushed coat on mild steel. The paint thicknesses were varied from 5 to 15 mils. Six tests were run on six panels for thermal shock. The panels were painted and after 72 hours curing time, were heated to 130° F.; then at peak heat, they were immediately submerged in 33° F. water. Each panel was subjected to six cycles. No damage resulted; the paint did not chip, peel, crack, or change color. There have been two different paint applications, both in the mine. One on mantrip cars, using a yellow color pigment, the other on underground ventilation fans without a color pigment. This application was made expressly for the acid and corrosion resistant properties of this Epoxy. Tests for acid

tight adhesion, and superior chemical resistance

HARDENERS AND CURING AGENTS are divided into two main groups: Room temperature hardeners, or baking, or high temperature hardeners. The most popular are: Amines, derivatives of ammonia, which frequently irritate the skin; Amine adducts are those chemically modified amines which usually reduce toxicity of the hardener and increase the curing speed; Organic acids are used only for unique adhesive applications and some coatings; Acid anhydrides which are dehydrated forms of organic acids and are preferred to the straight acids; Boron Trifluoride completes used to delay curing to permit more time to work on the resin while it cures; and Resinous hardeners which react with and cure Epoxies. Certain hardeners allow a partial curing at room temperature, but require an elevated temperature to complete the cure.

CURED RESINS is a hard infusible mass in which the Epoxy resin molecules are joined together in a three dimensional network of linkages and cross linkages.

Low shrinkage of unmodified Epoxies upon cure results because there are generally no byproducts during the cure. With no byproducts little molecular rearrangement is necessary so dimensional stability is preserved. High adhesive strength is partially attributable to this same factor.

ADDITIVES must be made to extend, improve, and modify the properties of the system because the Epoxy resin and its hardener seldom provide a material with all the properties desired for use in a given application.

The correct formulation of resin, hardener, and additives is a fairly precise task, and it is upon this result that the final properties of the system depend.

The wide range of applications results from the variety of additives which are compatible with the Epoxy resins, and which are used to adjust and improve the properties of the resin system.

COST varies widely depending on formulations for specific uses. Basic Epoxy resin cost is about 67 cents per pound. However, adhesives probably average $2.50 per pound with some special formulations costing as much as $7.50 per pound.

PRIMARY MANUFACTURERS: All Epoxy resin in the United States is produced by: American Marietta, CIBA Products Corporation, Devoe and Raynolds, Dow Chemical Company, Reichold Chemicals, Shell Chemical ompany, and Union Carbide Plastics Company. There are, however, more than 100 companies engaged in the formulation of Epoxy resins. Most of these formulators are the link between the resin producer and the end user. They serve the intermediate compounding function and provide technical service. One of the large problems to be overcome by the formulator is the manner in which consumers use and apply Epoxy. Formulators therefore must supervise the training of personnel in the proper choice of materials and the proper mixing.

This special section on the what and why of Epoxies was abstracted from the special book, *Epoxy Resins Market Survey and Users' Reference*, prepared for industry by Harvard Business School Graduate Students, and published by Materials Research, Box 363, Cambridge, Massachusetts. Price—$18.50 per copy. Permission has been granted for this summary by the publisher.

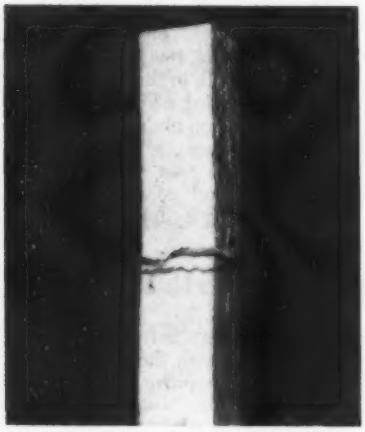
CRACKED BATTERY CASE at left and repaired battery case at right show how effective Epoxy No. 2 is in making repairs at a cost of only $1.00 per case.

resistance were run, using a metal-to-metal bond. The test panels were immersed for 45 days in sulfuric, hydrochloric, nitric, and acetic acid solutions, ranging from 20 to 100 percent strengths of each acid.

Failure of bond was observed in the solutions of sulfuric, hydrochloric, and nitric acids of 100, 80, and 60 percent strengths. No bond failure occurred in the five solutions of acetic acid. The lower percentage solutions were all subjected to a tension test and bond failure occurred at 1,000 pounds per square inch. Identical panels, when subjected to the same tests without being exposed to acid solutions, failed in tension at 1,050 pounds per square inch.

Approximately one year ago, struc-

Epoxy No. 2—Used by electricians to waterproof mine motors



CONCRETE TEST BEAM did not break along Epoxy joint above. New break was in concrete proving strength of adhesive.

This Epoxy has proven a boon to the electrical department in maintaining the motors on mine mucking machines. The motors on these machines were absorbing abnormal amounts of moisture, causing flash-over. Epoxy was brush-coated over the brush holders, brush holder supports and the inside surfaces of the motor cases. The coils were coated on the alternating current motors. Nine months after application there had been no motor failure due to flash-over.

Some of the oil-filled transformers were leaking at the joint where, in their construction, a steel plate adjoins a cast iron plate. All attempts to weld or braze this joint failed. Epoxy was brushed into this joint one year ago. No leaking has occurred.

The battery cases on the mine personnel lamps are exposed to excessive wear on the corners of the cases. Prior to Epoxies, these cases were replaced when worn so that the rubber liners were exposed. Repairing these cases with a build-up Epoxy at the wear points is now being done. A wear life on this patch now approximates the life of the parent material. Also, it is possible to repeat the repair many times without replacing the original case. We now estimate case replacement has been decreased approximately 85 percent. The cost of the repair to a badly worn battery case is about $1.00 in labor and material.

A feed-end 5 by 20-foot pebble mill head was recovered from scrap and repaired. This head was subjected to intensive wear due to liner failures. The liner face of the head was worn

Epoxy No. 3—Metal-to-concrete bond is stronger than concrete

Bonding metals to concrete has many practical applications at Climax. Epoxy No. 3 proved suitable for a bonding agent. Field tests were conducted in the mill and mine for adherence, tensile strength, and ease of application. Epoxy No. 4 is a two-part material, containing a catalyst and an adhesive. Neither of the parts are toxic nor in any way objectionable to use.

Climax has searched for a faster, more economical way to bond metal to concrete, with such applications in mind as hangers for pipe, conduit cable, small tools, etc.

Tests have been quite successful in using Epoxy No. 4 for this purpose. The first field tests were made by using pieces of unistrut measuring 1½ by 12 inches. The metal face to be bonded to the concrete was wire-brushed and all scale, dust, etc. removed from the brushed area with a cloth. Concrete was selected that had a 28-day strength of 5,400 pounds per square inch and has been in place for six years. The surface preparation on the concrete was identical to that performed on the metal surface. A coating of Epoxy No. 4 was troweled to a thickness of approximately 1/16-inch on each of the surfaces to be bonded. After an open time of 15 minutes at 70° F., the surfaces were placed together and shored in place to prevent sagging until a curing time of 24 hours had elapsed. A hook was installed in the unistrut and a direct tensional pressure exerted on the bond. Failure occurred at 140 pounds per square inch. The bond on metal surface remained intact, and the bond to the concrete had approximately ¼ inch of concrete adhered to it.

This same test was duplicated, using flat mild steel, However, it was desired to ascertain the heat resistant properties of the bond; consequently, braces were welded on the steel after the bond was 24 hours old. The bond failed at 95 pounds per square inch and visual inspection proved a definite deterioration of the epoxy due to the heat of welding. Thus, it was determined that hooks, braces, hangers, etc., should be welded to the steel prior to the bonding procedure.

tural steel was painted in the byproducts plant beneath the pyrite flotation machines where an acid condition exists. To date we have not observed any damage to this application except a slight change in color.

Mine battery motors have required a great deal of maintenance due to corrosion, dust, and moisture. This same Epoxy paint was brush-coated on the battery cases and battery trays. This application was made in September 1959 and visual inspection during late December 1959 proved no deterioration either to trays or batteries; no water, dust, or alkaline deposits were evident.

Concrete foundations under cone crushers were failing and in some instances had to be replaced. This was due to extreme abrasion on the inner surfaces of the concrete. Angle and horizontal patches were so successful that we tried a vertical patch on these foundations, using the same Epoxy as outlined above. We did, however, place a few metal dowels in the old concrete to help hold the sag of the new material until the Epoxy could cure to full strength. Again, metallized aggregate was used to extend the abrasion resistance curve. The application was made late in 1959 and the crusher was placed on continuous 24-hour duty. After 90 days there occurred a very minimum amount of wear, and no bond failure was evident. Plans are to build up the inner surfaces of the foundations under the 60-inch gyratory crusher using identical materials.

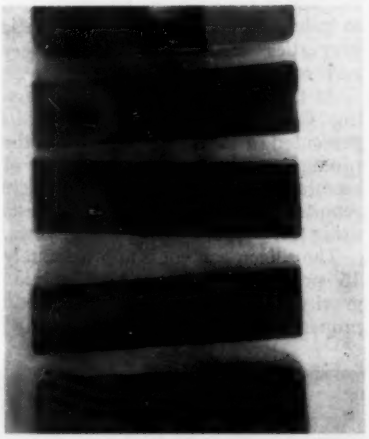
All of the aforementioned applications were made with the No. 1 Epoxy resin with some modifications, which, as explained, are stock items. This material is packed in pint, quart, and gallon containers. The bond thickness when used as an adhesive is 15 to 20 mils, and as a paint application 5 to 15 mils. This material is slightly toxic when used in tight, closed areas; however, normal ventilation is all that is required for most applications. The catalyst should be handled with some degree of caution; direct contact with eyes or mouth will cause great discomfort. Once this material is set, it cannot be redissolved. In the hardened state its appearance is similar to that of porcelain enamel.

and to bond metallized aggregate to worn pebble mill head

to a thickness of about ¾-inch. New liners could not be bolted to the head because of the uneven surface, plus the thinned state of the parent metal. The inside surface of the head was thoroughly cleaned and Epoxy resin was troweled on the metal. This coating was ¾-inch in thickness; we then troweled a metalized aggregate to the Epoxy, and built up this patch to the original shape and thickness of the head. The repair was allowed to cure undisturbed for 48 hours. All attempts to break the material or the bond proved futile. The head is now in service at a tremendous savings. The cost of this repair was about $75.00 including material and labor.

Mineral insulated cable splices may be sealed effectively, due to the dielectric, high adhesion, and waterproofing properties of this particular material. We have repaired bakelite and plastic photographic equipment at practically no cost.

This type of Epoxy is packaged in kits, each containing 24 100-gram glass jars of resin. The catalyst is packaged in a bulk container. The kit includes a graduate for measuring the proper amount of catalyst to be added to the contents of each jar. The accelerator for this type Epoxy is quite toxic and has a dangerous burn characteristic. These properties are evident only when the accelerator is separate. Upon mixing the adhesive and accelerator, the finished product becomes very stable with low toxicity and no burn characteristics. The viscosity of this material when mixed is comparable to a heavy paint.



RESULTS of 45 days immersion in 100, 80, 60, 40, 20 percent strength acids are shown in panels above.

Epoxy No. 4—Proves best for rubber-to-rubber bonding agent

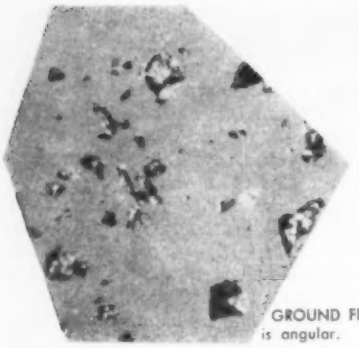
An excellent adhesive for cold rubber patchwork was found to be Epoxy No. 4. The material is a three-part, three-coat application. The product consists of a primer, an adhesive, and an accelerator. The laboratory tests prove a peel-back strength of 15 to 20 pounds per square inch on the rubber to steel application. The rubber-to-rubber peel-back strength is 10 to 15 pounds per square inch.

Climax uses high-speed conveyor belts which, due to their speed, cause the crushed ore to "boil" on the belt, creating terrific abrasion to the metal splice clips. Splices were indented and clips attached. Epoxy was applied to the indented area and to a neoprene sheet; the sheet was then placed over the clips. The splice life of these belts has been tripled.

This same application has been made on rubber-lined flotation machines, high-pressure filters, rubber-lined pipe and launders, with excellent results. Application is made this way: First apply a 15-mil thickness of primer on both surfaces to be bonded; allow to dry for one hour; mix the adhesive and accelerator together and immediately apply one coat (approximately 5 mils) to each surface. After a 15-minute interval, apply the second coat of 5-mil thickness to each surface and immediately place the two-coated surfaces together. Contact pressure is all that is required. Normal curing time is 24 hours; however, the curing time can be reduced to one hour by applying a heat of 150° F.

This material is very stable. Parts one and two have a very low degree of toxicity and have no burn characteristics. Part three is of a higher degree of toxicity, but has no burn characteristic. Normal sanitary habits are all that is required in handling this material. The viscosity of this material when applied is comparable to thinned paint.

In conclusion, we at Climax feel Epoxy resin adhesives to be another very welcome addition to the expanding list of aids to a more economical and efficient mining and milling operation. END



GROUND FERROSILICON is angular.

Why An Atomized proves superior for

By Dr. Franz Rodis and Dr. J. Cremer.

Heavy media separation of ores has increased steadily so that today minerals as valuable as diamonds or as common as iron are being recovered in ever increasing tonnages.

Ferrosilicon is by far the most widely used medium. It has the advantage of high specific gravity, and greater hardness in comparison to magnetite, for example. In comparison to galena it possesses good magnetic properties which facilitate recovery and reuse.

At the International Mineral Dressing Congress in 1955, Dr. Roddis presented a detailed paper[1] on the production and characteristics of atomized ferrosilicon. Now this article reports operating experiences and tests using this product during recent years.

The silicon content is approximately 15 percent. It has a high specific gravity and well developed magnetic properties. With a silicon content of 18 to 20 percent, the specific gravity is perceptibly lower and the magnetization comes close to the limit where it is still profitable for practical use.

This new ferrosilicon is now made by Knapsack-Griesheim A. G., near Cologne West Germany, by atomizing the molten liquid after it is tapped from an electric furnace.

The resulting particles are quenched in water, and the powder, which after draining still contains approximately 10 percent water, is dried and screened. This process is similar to the production of metal powders used in powder metallurgy. Provision must be made for the rapid use of substantial quantities of steam from the operational system without disturbing the pressure. Approximately two tons of steam are used per ton of ferrosilicon.

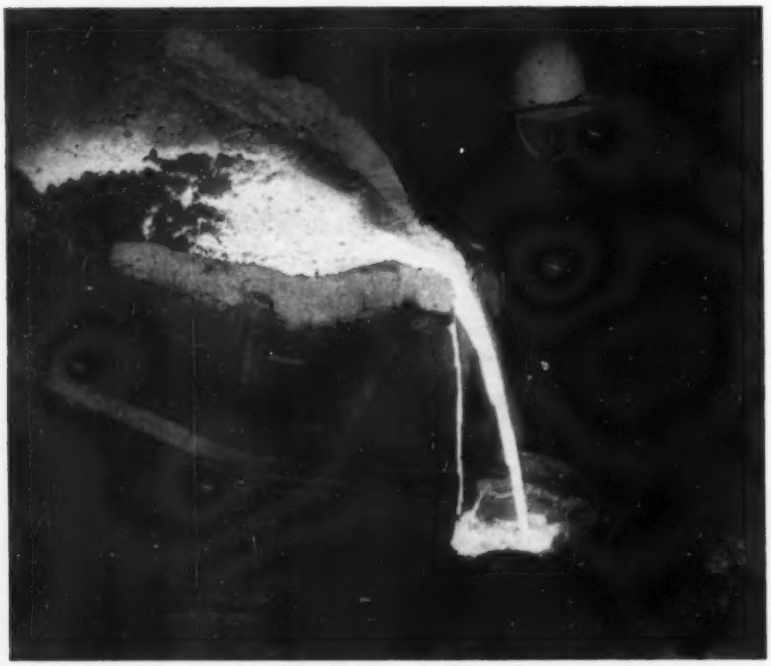
Atomizing produces both fine and coarse particle sizes as desired. Controlling factors are steam pressure, temperature, and the composition of the ferrosilicon melt. It has been found to be of special advantage if copper and other alloys are present in the melt. Certain concentrations have to be maintained of these metals in order to obtain a good powder by atomization. Similar to ground ferrosilicon the atomized ferrosilicon particle size distribution on the Rosin-Rammler diagram is represented by a straight line shown in Figure No. I. This was not quite expected.

It is clear that two different processing methods—grinding and atomizing—result also in different properties of the powders obtained. A decisive factor for the different characteristics of these two products of a similar chemical composition is the physical condition of the surface of each individual particle. The ground powder shows sharp corners and edges and has a rough surface. The individual atomized particle has a sphere-like form as well as a smooth surface which is especially hard due to the quenching step.

It can be assumed that, besides the different surface conditions, the mechanical activation of the ferrosilicon during grinding determines the different behavior of the two types of powders with respect to: corrosion, viscosity of pulp, and losses of adhesion.

These three characteristics determine, among others, the economy of operation of a heavy media plant.

Strength and the magnetic properties of both ferrosilicon powders are comparable.



POURING MOLTEN FERROSILICON from ladle into atomizing chamber where a jet of steam atomizes the white hot alloy into spherical particles.

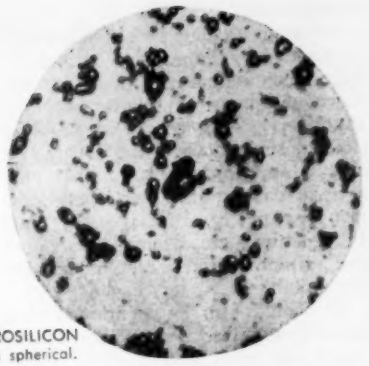
How Corrosion Reduced

After repeated wetting and drying the ground ferrosilicon begins to rust with formation of hydrogen gas. Microscopic examination and tests have shown that the development of hydrogen generally starts at the corners and edges, where, according to the latest theories in surface chemistry, very active rust-forming influences are present. Thus corrosion cannot be avoided by chemical additions, not even copper, because it depends on

Ferrosilicon

heavy media plants

Knapsack-Griesheim AG., Knapsack, near Cologne, West Germany



ATOMIZED FERROSILICON is spherical.

the surface conditions. Another point is that during the ore grinding process iron particles are worn off the grinding media. These iron particles subsequently are either mixed with or adhere to ferrosilicon particles to form so-called "local elements" or electrocouples which strongly promote the formation of rust. These "local elements" are also formed within the individual ferrosilicon particles if several chemical compounds between iron and silicon segregate as the tapped melt cools slowly.

Such corrosion results in agglomeration of the settled powder with a sizeable liberation of hydrogen gas as follows.

$$Si+2H_2O=SiO_2+2H_2$$

$$2Fe+H_2O+O_2=Fe_2O_3+H_2$$

The silicic acid and the ferric oxides occur as hydrates which cement the particles.

Atomized ferrosilicon, however, behaves differently. The individual particle does not offer preferential points of attack to rusting, because its surface is round and smooth. With the rapid quenching technique during manufacturing, segregation of the various chemical compounds does not occur. Contamination by iron particles from grinding does not exist. Therefore, agglomeration of the settled medium does not occur. Experience shows that even after week-end shutdowns, heavy media plants can be restarted without any trouble. After operating 20 to 30 minutes the media is in complete suspension, and the feeding of ore may be started.

Of course, the formation of hydrogen gas can be avoided only with pulps which are not acid. Acidity may result when sulphide ores are being treated. In this case, hydrogen sulphide or sulphur dioxide is formed, thus lowering the pH. Continuous control of the latter is then necessary to prevent it from dropping below 6.5. In such cases, an addition of small amounts of lime is necessary. Media loss through corrosion, which is 10 to 15 percent of the total loss of ground ferrosilicon, is considerably lower when atomized ferrosilicon is used.

Five to six years of operating experiences has shown superior resistance to corrosion of atomized ferrosilicon. In many cases when the ferrosilicon was exposed to moisture during storage there was no rusting or binding. There was no trouble or delay in restarting the plants and using the product.

The apparent starting of corrosion was reported in only two cases. Both had especially unfavorable conditions; a long shutdown of the plant, and a high temperature of the pulp. A thorough laboratory examination proved, however, beyond a doubt that no corrosive changes, as indicated by a rusting of the atomized ferrosilicon, had taken place. A yellow to brown color development and lumping tendency, during long shutdowns, may be attributed to the ferric oxides which are finely distributed in the ore pulp. These oxides are formed from the corrosion of the machinery and grinding abrasion. The oxides coat the surfaces of the ferrosilicon spheres and thus simulate corrosion by their coloring effects.

This process is greatly favored by the capillary forces which are active in the stored ferrosilicon pile. If the ferric oxide content of the pulp is especially high, it is possible that the rust shells, covering the unchanged spheres, will agglomerate, thus resulting in the lumping tendency.

It can be satisfactorily proven, even after the surface changes, that atomized ferrosilicon in the presence of water and a sufficient air supply does not rust when kept in glass containers. However, when storing in iron containers, the latter corrode, thus the rust formed gradually covers the ferrosilicon particles coloring them yellow to brown. These phenomena are greatly accelerated at higher

ATOMIZED FERROSILICON is made at the Werk Knapsack of Knapsack-Griesheim AG, near Cologne, West Germany.

temperatures.

Apparent rusting and sticking can be avoided by thoroughly washing the ferrosilicon before the plant is shut down and by storing it in rustproof containers. The corrosion problem during shut downs can easily be avoided by applying a suitable protective coating to iron containers, using natural or artificial resins, rubber coatings, etc. Storage containers made from wood, ceramics, or concrete are suitable.

It should also be mentioned that use of atomized ferrosilicon causes much less wear and tear on pumps and motors than does ground powder. This is due to the round atomized ferrosilicon particles. This is an economic advantage because it lowers costs of operation at heavy media plants.

Density Increased

Heavy liquid separation of relatively small sized feed is possible providing the viscosity does not exceed the tolerable limit.

When plotting the viscosity against the pulp density, the range of serviceability is confined to the horizontal section plus the first one-third of the rising part of the curve. Lacking a suitable analytical procedure for the suspension (non-Newtonian liquids), viscosity of three pulps was determined with a run-out viscosimeter. The accompanying graph in Figure No. II shows the influence of particle shape on viscosity. It has long been known that for the same pulp density and the same screen size a spherical shape produces a lower viscosity than material with corners and edges.

Natural adhesion will occur to a much greater extent between those particles having a rough shape and surface characteristics that are partly flatter than between ball shaped particles with surfaces which are smooth and hard. Atomized ferrosilicon particles are smoother to start with than are the nearly worn-to-a-spherical-shape particles formed by use of crushed material.

The graph shows that for a viscosity of approximately 12 centipoise a pulp density of 3.3 can be attained with irregular shaped media, 3.45 with atomized media, and a 3.7 density with a special grade consisting of spheres only. In normal operating plants a density of 3.1 to 3.2 is reached with ground ferrosilicon, 3.55 with atomized material, and 3.9 with special grade. A large German plant is using a 3.55 density, and a modern South African mill treating diamonds has a 3.8 density.

Thus pulp densities have been increased without increasing viscosity. Conversely, for equal pulp density, the use of atomized ferrosilicon will result in lower viscosity.

An increase in density opens up new applications and sharper separations. It is conceivable that fluorspar and barite can be separated at 3.8 density.

A recent attempt has been made in Germany to automatically control medium viscosity with a viscosity meter.

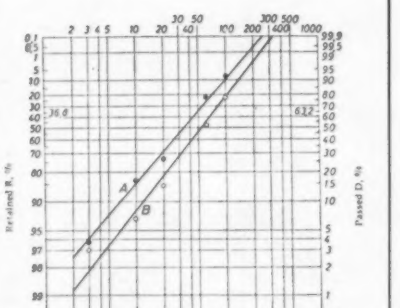
Adhesion Losses Reduced

Ferrosilicon is not always washed completely free from either the float or sink product in heavy media plants. Tests were made which showed that from 20 to 60 percent less adherence loss resulted from use of atomized material.

Adhesion losses have been calculated by several operating companies treating a variety of ores. Actual mill results are as follows: Ilseder Hütte, a loss of 500 grams per ton treating iron ore with clay and marl nodules, but a loss of only 100 on concentrated iron ore. Gewerkschaft Auguste Viktoria reports a 170 gram loss on lead-zinc ore. Sachtleben A. G. lost 67 grams milling barite. Erzbau Salzgitter, AG. had a loss of 40 grams on iron ore, and Erzbau Siegerland only a 30 gram loss for iron ore. The importance of the surface condition of material being milled is clearly demonstrated.

Identical Magnetic Properties

Microscopic examination has shown the atomized ferrosilicon contains cavities, particularly the larger sized particles. However, even the larger sizes, above 0.1 millimeter, contain only 1.8



Micron Size	A Fine Fraction Percent	B Coarse Fraction Percent
0 to 3	3.7	3.1
0 to 10	16.5	6.7
0 to 20	27.3	15.0
0 to 60	76.5	52.6
0 to 100	91.7	75.9

FIGURE NO. I.
Size fractions of atomized ferrosilicon

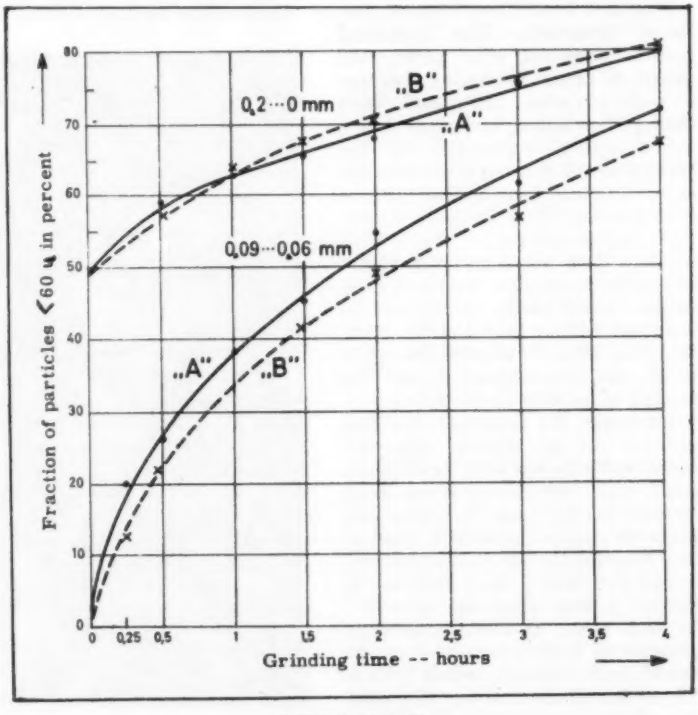


FIGURE NO. II.
Influence of particle shape on pulp viscosity

percent pore space and actual operating results prove that this is not detrimental for use as a medium. The smaller particles are solid throughout with no cavities.

Comparative strengths of the two types were determined by a series of abrasion tests. These were carried out in a small ball mill. Equal size fractions of less than 2 millimeter size were ground for several hours under uniform conditions, and the 60 micron fraction determined after different grinding periods. The abrasion graph shows that, after 30 minutes the ground ferrosilicon showed increased abrasion, whereas only after a longer period the atomized ferrosilicon yielded a greater amount of fine material.

A chosen fraction of the total material, for example a particle size distribution of 0.06 to 0.09 millimeter shows greater abrasion for the regular than for the atomized powder. See Figure No. III. The differences of these measurements are small, however, and may well be within the tolerance of experimental errors. From the abrasion tests, it may be concluded that the strength of the atomized powder is not less than that of the ground powder.

The magnetic properties of the atomized ferrosilicon are at least equivalent. In one case a customer reported a lower demagnetizing factor. After leaving the demagnetizing coil the pulp was still nonhomogeneous, which

Adhesion Losses of Ferrosilicon in Grams Per Ton

Type Ore	Ground Ferrosilicon	Atomized Ferrosilicon	Percent Reduction Using Atomized
Chalcopyrite from Meggan	358	54	85
Iron ore from Fortuna	275	246	11
Iron ore from Salzgitter	256	151	41
Siderite from Siegerland	148	59	60
Pebbles			
Smooth	353	180	49
With fissures and cavities	520	410	21

can be explained by the coalescing of the particles due to residual magnetism. This phenomena could be eliminated by an increased capacity of the demagnetizing coil, i.e. by means of a greater intensity of field. Laboratory tests have proven that atomized ferrosilicon can be more intensely magnetized and, therefore, more easily separated than the ground product. In the above mentioned case, it would have been possible to decrease the capacity of the magnetizing coil in order to achieve the same effect, i.e. a homogeneous pulp. However, if the intensity of field is left unchanged, which is the common procedure in practical operation, the stronger magnetizing of the atomized ferrosilicon, achieved thereby, will have to be compensated by a greater demagnetizing intensity of field in order to practically achieve a complete demagnetizing.

The different magnetic behavior of the atomized ferrosilicon is probably due to its different crystallographic constitution.

To sum up, it may be stated that the good results obtained to-date with ferrosilicon pulps of the ground powder have been improved with atomized powder. This has been proven by the operational results at a large number of heavy media separation plants over a period of several years. Further information has been published in various European technical magazines.[3] END.

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3. *Erzmetall* 5 (1952), p. 114; 6 (1953), p. 336, *Stahl und Eisen* 74 (1954), pages 1071, 1072, 1074, 1075.

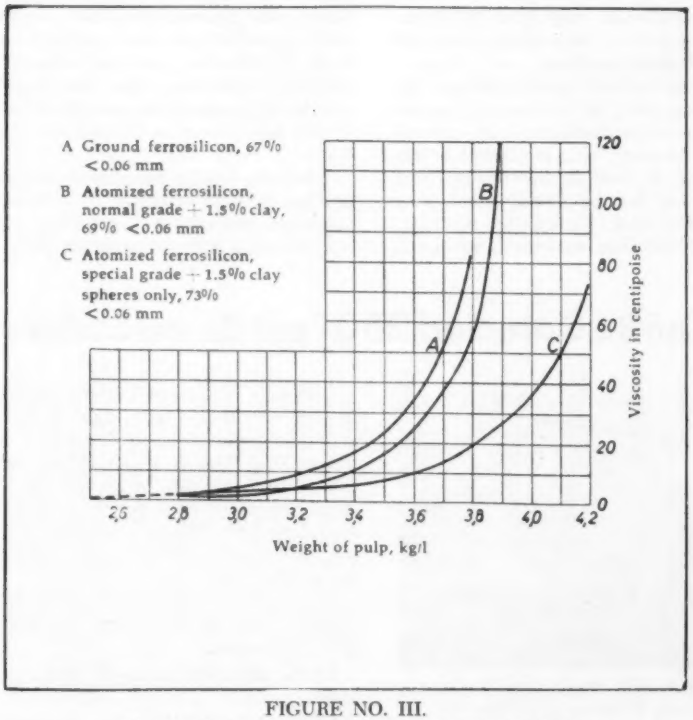
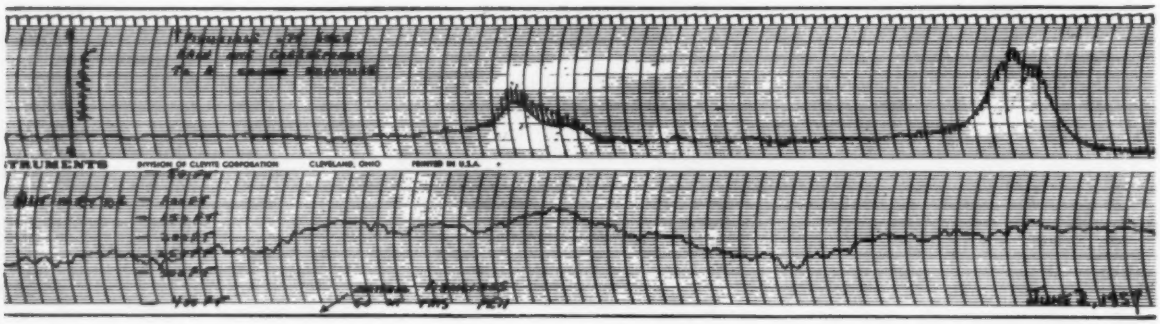


FIGURE NO. III.
Abrasion test results: "A" ground and "B" atomized

Dr. Franz Rodis
Inventor of atomized ferrosilicon.

Super-Sensitive Electromagnetic Unit

Developed By Texas Gulf Sulphur and Varian Associates For Small Helicopter Transportation Is First Used In Northern Canada Where 178 Line Miles Are Flown Per Day



SMALL CONDUCTING BODIES are indicated by peaks on top strip. The normal operating sensitivity of 400 parts per million full scale was used for this flight. The bottom graph is the altimeter record of the height that the helicopter flew. Each time interval at top of upper strip represents 0.75 second and corresponds exactly with each camera exposure.

Texas Gulf Sulphur Company needed a low-cost, sensitive, lightweight, electromagnetic geophysical prospecting unit with deep penetration possibilities which could be transported by a small helicopter in Canada. To meet these requirements, Texas Gulf turned to Varian Associates of Palo Alto, California, which had pioneered miniaturization and transistorization of scores of electronics components from missile microwave transmitters and airborne radar tubes to magnetometers.

Selection of EM as a major exploration tool by Texas Gulf was only natural because the method is one of the best yet developed for locating buried sulphide deposits. Texas Gulf is interested in all such deposits, first, because they may be sulphides of valuable metals such as copper, lead, zinc, and nickel; second, in large sulphide deposits as such (pyrite or pyrrhotite), because they contain sulphur in large quantities. Texas Gulf, as the world's largest sulphur producer, must have reserves of sulphur in all forms in many parts of the world to maintain its first-place position.

Varian, which revolutionized exploration with its lightweight, proton free-precession airborne and ground magnetometers, was interested in expanding its line of instruments and contracted for the development of a new EM unit. Under the contract, Texas Gulf has exclusive use until March 1, 1960.

Varian's electronic engineer, Kenneth Ruddock of the Instrument Division, was assigned to the project. Airborne geophysical prospecting was a well-known science to him because he had worked for Newmont Exploration Ltd. for eight years before joining Varian in September, 1957. Texas Gulf's specifications were outlined by H. V. W. Donohoo, assistant manager, Mining Exploration, who has taught geophysical exploration, and practiced it, too, for a number of years in the West.

The new Varian instrument brings nothing new in principle to Electromagnetic prospecting. The transmitter coil sets up a large AC magnetic field.

Major Conducting Bodies Can Be Detected 250 Feet Below Surface

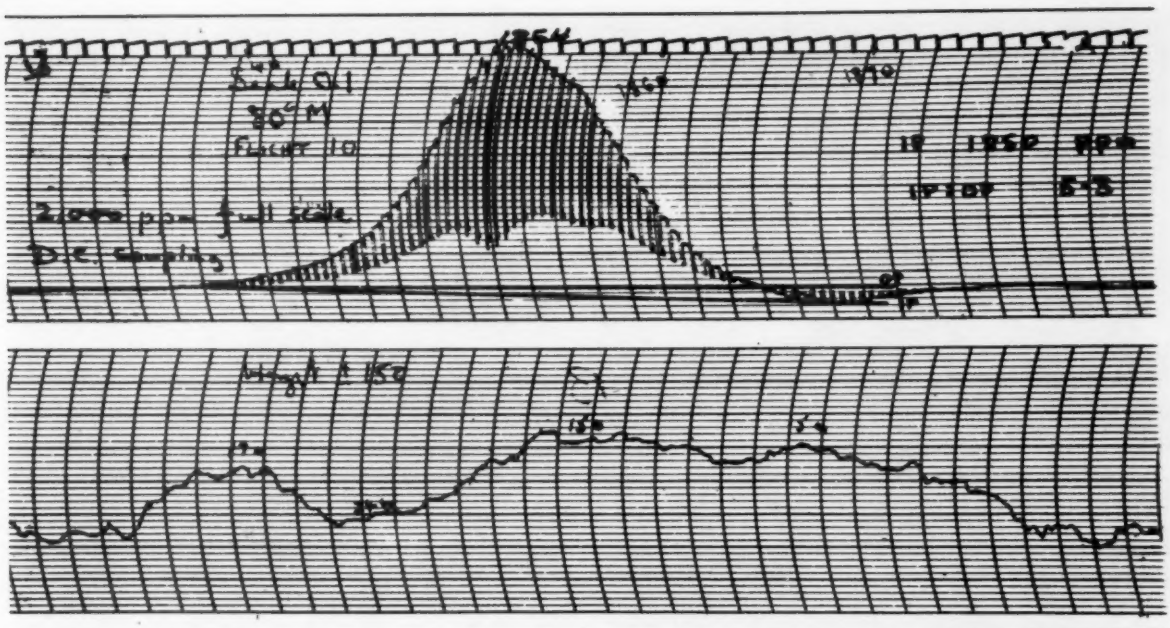
VARIAN ELECTROMAGNETIC equipment on Bell helicopter. Transmitter is mounted on end of boom at left, pick up coil on right end. Camera is mounted in white case on near side with electronic equipment in case on far side just under plastic nose.

The new Varian instrument brings greater sensitivity, with light weight and thus lower costs, to airborne EM prospecting. This is achieved because the instrument can be flown by a small helicopter with greatly reduced operating costs. When conditions permit, the small helicopter flies lower for greater detail, too.

Here are highlights of the new instrument and its mounting on a Bell 47G2 helicopter:

COIL SEPARATION—50 feet, coaxial.

COIL MOUNTING—On opposite



EM ANOMALY from west to east flight over International Nickel Company's Whistle mine, Sudbury, Ontario. Sensitivity reduced to 2,000 parts per million full scale to keep the in-phase response on scale. Note excellent signal-to-noise ratio. The in-phase negative at the east end of anomaly is caused by magnetic material in the ore body.

Any conductor within this field will distort the magnetic field because of eddy current flow within the conductor. The receiver coil then measures the distortion of the original field. The instrument thus measures conductivity changes. These could be due to many things other than a sulphide deposit, but in Canada many such changes are caused by sulphides.

In the field, the geologist and geophysicist lay out a well-planned grid on a large aerial photograph for the pilot to fly. The parallel flight lines are typically ¼ mile apart. Normal flight height is 150 feet above the terrain at 60 miles per hour. During the first 65 days of use in northern Canada, an average of 132 miles of grid line was flown daily. Discounting the days lost because of bad weather, or necessary aircraft maintenance, production averaged 178 line miles per flight day. As many as six flights have been made in one day in good weather.

Once an anomaly has been picked up, it may be reflown on a closer grid; for those areas where a further check is needed, the greater maneuverability of the small helicopter pays off because an airborne check in great detail is possible. This detailed information is very valuable to the geologist and geophysicist who do the ground work to spot drill hole locations.

As the helicopter flies over an area, a camera takes a continuous series of pictures to pinpoint location of the aircraft at any time. Pictures are numbered in sequence for correlation with the EM record. From these pictures the flight path is later plotted on large aerial photo mosaics. Simultaneously, the radio altimeter measures and records height above ground. A recorder continuously records electromagnetic signals. By using "time sharing" or "multiplexing", the recorder weight has been reduced because only one pen is needed to display the two channels of EM information. The recorder displays directly the relative amplitude of in-phase to out-of-phase signals. The in-phase is recorded for 250 milliseconds, and the out-of-phase for 100 milliseconds.

With 400 Cycle Unit Having 50-Foot Coaxial Coil Separation

ends of a specially designed boom reinforced for maximum rigidity. A change of as little as 0.004 of an inch in the 50.0-foot coil separation can cause the same signal to be induced in the receiver coil as a major ore body at maximum range. Thus, a very rigid boom is necessary to prevent the receiver coil from picking up spurious signals or noise directly from the transmitter coil. A "buck-out" coil in front of the receiver eliminates the direct field at the receiver coil which is set up by the transmitter.

ENGINE NOISE LEVEL—This was held to a negligible level by careful magnetic shielding on the magnetos and generator. This meant that it was possible to reduce transmitting power while still making the instrument more sensitive.

LANDING GEAR MODIFICATION—An extended landing gear for the helicopter is provided as part of the system. This special gear raises the helicopter sufficiently to permit mounting the boom underneath between the skid tubes.

TOTAL WEIGHT—Only 300 pounds, including camera, radio altimeter, modified landing gear, and recorder.

POWER SOURCE—Aircraft system, 40 amperes at 24 volts for all equipment.

EM OPERATING FREQUENCY—400 cycles maintained within one cycle. However, frequency can be varied to meet special conditions.

The instrument has detected large known conductors 500 feet below the aircraft and is considered useable at 400-foot range. With normal flight at 150 feet above the surface, this means that the sensitivity and signal-to-noise ratio permit the detection of major conducting bodies at least 250 feet below the surface. END

MAIN HOISTING SHAFT has six compartments. All mine water is pumped through separate shaft.

MINING WORLD photographs.

LEAD CONCENTRATE, now, as formerly is treated in Newnam hearths in building in background. Note hand tramming.

ZINC BLAST FURNACE will be installed

By MINING WORLD's special traveling contributor in Africa

The Rhodesia Broken Hill mine is to be equipped by 1962 with the Imperial Smelting Corporation's new blast-furnace process for the simutaneous, though separate, production of lead and zinc. Overall capital cost, including an additional water power unit, will be $12,000,000.

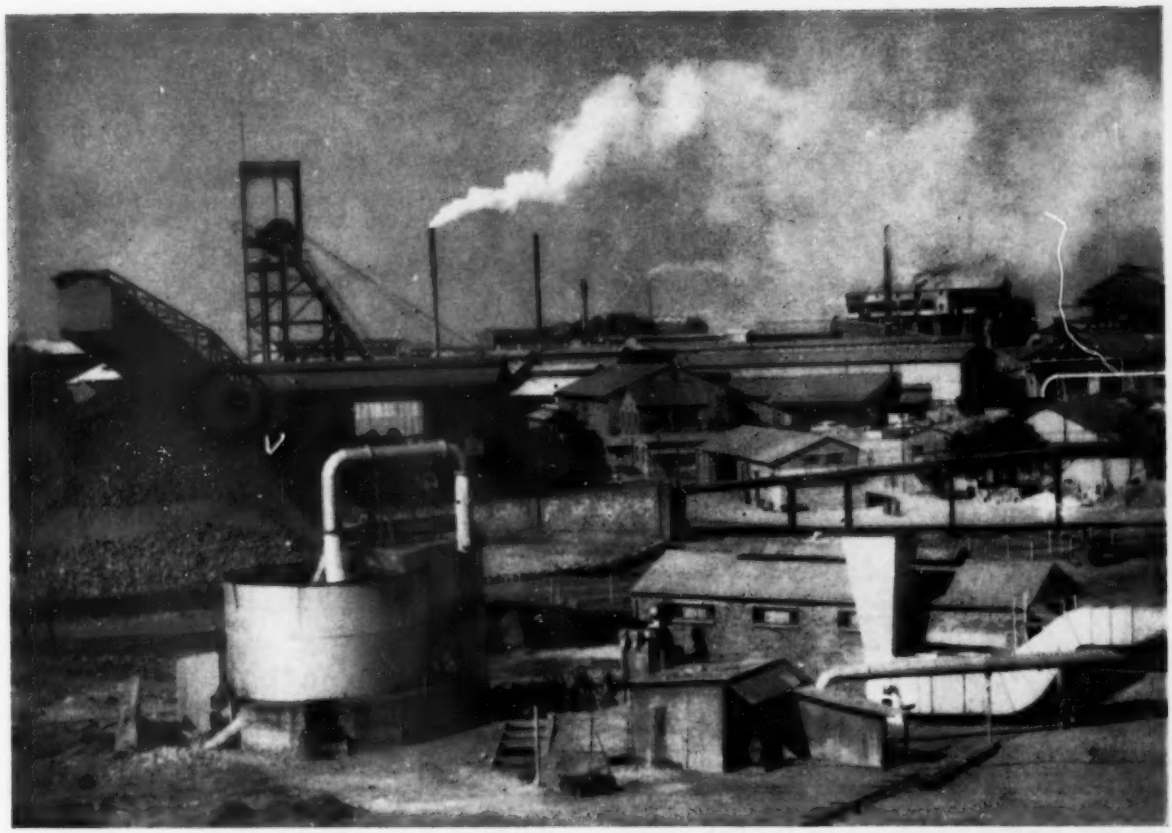
The mine and auxiliary metallurgical plants at Broken Hill, Northern Rhodesia, are operated by the Rhodesian Broken Hill, Development Co. Ltd., one of the group companies of Anglo American Corporation of South Africa Ltd.

For several months, a project team of wide experience has been studying on the spot the economics of the furnace as applied to the diverse ores and products—sulphide and oxides, high- and low-grade—available underground or in surface accumulations. For a fully equipped property, with its own cheap power, this decision predicates both courage and confidence..

It also stands as a tribute to the South African group system. Little doubt that, except for Anglo-American's technical and financial resources, the risk of such a revolutionary change of practice would never have been taken. The high cost of smelting rights, drawings, and "know-how" alone would have been enough to scare off most independents.

Ore reserves, 38 percent in oxides, approach 5,000,000 tons assaying 28.6 percent zinc and 15.3 percent lead, give promise of many years of prosperous stability. Some 220,000 tons of combined metal are also available in surface accumulations; an estimate according well the record of 1,000,000 tons of metals won to date. Losses have been heavy, as annual reports disclose. A recovery of only 60 percent combined metals will be raised to better than 85 percent with the new smelting process.

The new smelting process, described in the October 1957 issue of MINING WORLD and which was the "Technical Development of 1957", may be briefly reviewed in the Rhodesian context. The furnace will be charged with a mixture of sinter-roasted concentrates, which will be as hard, lumpy, and free from dust as possible, and 3-inch metallurgical coke. The furnace gases, a mixture of zinc, CO and CO_2 are shock-cooled by a spray of molten lead, whereby up to 90 percent of the zinc vapor is condensed and drawn off as metal, while the lead is tapped at the bottom. Additional recovery is effected in zinc compounds caught in the condenser. The furnace is air-blown, without oxygen enrichment, a factor deemed to be of high importance in preventing reoxidation of zinc within the furnace. Back re-



ZINC METALLURGICAL PLANTS at Broken Hill look like this today. This panoramic view shows the electrolytic precipitation plant, just to right of main shaft, the leach plant, sulphuric acid plant, and the sulphide concentrate roaster.

by Rhodesian Broken Hill

action was one of the snags in the early development.

Consumption of coke will be heavy but the high lead content of Broken Hill ore will not demand more fuel than for the zinc alone. Good metallurgical coke is obtainable from the Wankie colliery, 440 miles distant on the main railroad, under the same group control.

That the "antiquated" blast furnace should be staging a come-back, in this dual purpose role, is the more remarkable in that an Italian blast furnace and sintering plant was installed at Broken Hill in 1954, for lead, with disappointing results.

Two years of intense activity, resulting in a change of local skyline, lie ahead of general manager, P. G. Gleeson, an Australian metallurgist of long experience at Broken Hill, supported by mine manager, J. C. Burke. Sweeping changes will have to be made below the crushing, heavy media separation, and flotation milling units, which feed today the conventional recovery plants. Lead concentrates are being treated in Newman hearths to which reversion was found necessary during 1958, owing to blast furnace inefficiency.

Zinc concentrates pass from the flotation plant to a flash roaster, followed by the normal leaching, Moore filtration and electrolytic recovery.

The new process may not lead to any great lengthening of mine life. Ore deposit walls are sharply defined, though on dip there is some scope for an elastic paylimit. Lead values tend to decline in depth more rapidly than zinc.

A physical characteristic of interest, since water level was at a depth of only 50 feet when mining started, is the sheath of oxidized ore surrounding the rich sulphide bodies, even to a depth of 1,000 feet. Further, making it clear to the metallurgists that they have no monopoly of the technical problems, ore-filled caverns in the dolomite walls, due to dissolution and oxidation, are troublesome occurrences during mining. Vanadium, found in this filling, used to be profitably recovered.

A modified shrinkage system of stoping is practiced with sub-level development, long-hole drilling, and mechanical loaders in crosscuts from footwall drives. Squares set and top-slicing methods have been abandoned.

Inflow of water, which averages 14,000,000 gallons daily, is quickly responsive to climatic conditions and exceeds 20,000,000 in a wet season. All pumping is done from 1,050 and 1,550-foot levels at a special water shaft, named after the eminent United States mining engineer, Carl Davis, who rendered great service to the company during its early struggles.

Little more than 50 years ago, Broken Hill was a northern outpost of white civilization, playing a most important part in the development of the two Rhodesias. End

BOOMER MINE opens a new geological frontier. Look for high-grade beryllium minerals in veins. Don Peaker, center, president of U. S. Beryllium Corporation, checks stope on mine's 30-foot level west of Colorado Springs, Colorado.

Boomer Mine

Non-Pegmatite Source of High Grade Beryllium Ore From Hydrothermal Vein

Interest in beryllium in the last year has rocketed ahead as fast as its growing use in missiles. Most of the attention has been given to the metal and its first successful forging for the Project Mercury manned space capsule.

The nuclear field has been the largest consumer of beryllium metal where it is used as a moderator to take advantage of its low rate of neutron absorption. However, it has been only during the last year that the rocket and missile speed up has focused attention on beryllium as an important structural metal. Researchers and fabricators have forged and extruded beryllium shapes; much progress has been made to overcome brittleness.

While there never has been any shortage of beryl ore to meet metal demand, the accelerating use potentials point to increasing ore requirements. Fortunately the geologists and mining engineers have been very busy and the following four developments all point to an increasing production of beryllium minerals.

The developments are: commercial production of beryllium minerals from a high temperature vein at the Boomer mine in Park County, Colorado; the invention of the portable "berylometer" for field detection of beryllium minerals; the realization that beryllium minerals are far more common in veins than heretofore known; and the discovery of large but low-grade reserves in the workings of the Mount Wheeler Mines Inc. in Nevada.

The U. S. Beryllium Corporation of Pueblo, Colorado is the operator of the Boomer mine and has a 45 percent working interest in the nearby Blue Jay mine. Don H. Peaker, a geological engineering graduate of the Colorado School of Mines, is president and treasurer of the corporation.

In the last two years the Boomer has been one of largest beryllium mines in the United States. Nearly all of its shipments have been to the United States government's buying station at Custer, South Dakota. For two years, ending February 1, 1959, these were valued at $233,840. Production for 1959 continued at about the same rate with the possibility of reaching an all-time annual dollar high. Shipments until February 1, 1959, were 485 tons assaying 10.15 percent BeO with an average value of $464.00 per ton, and 98 tons of dump assaying 3.21 percent BeO with a value of about $100.00 per ton.

Beryl Vein Is High Temperature with Fluorite and Topaz

All production has come from veins a few inches to several feet wide cutting pre-Cambrian schist. At depth the veins enter the well known Pikes Peak granite.

A typical vein is a quartz fissure containing galena, chalcopyrite, fluorite, topaz, sericite, and very small amounts of gold and silver. It is most unusual to find sulphides in the same vein with beryl minerals.

Most of the beryllium occurs in coarse crystals of beryl, but bertrandite is found in many places. This high-grade (42 percent BeO) mineral is one reason mine ore has been so high grade. It is a colorless beryllium silicate formed by hydrothermal alteration of the beryl.

Beryllium minerals are found in irregular masses along one wall of the quartz veins with highest concentrations where granite is the wall rock. Lenses and pods of greisen at times form one wall of the veins. This is considered to have been formed by alteration of the granite by mineralizing solutions.

Actually the Boomer is an old mine which was located many years ago and developed as a silver-lead prospect. Operations were discontinued some years ago after mining to 100-foot depth and the property remained idle and abandoned until a prospector identified the beryl a few years ago.

All of the ore has been stoped from four levels driven from the 100-foot-deep shaft.

High-grade beryl—almost gem quality—has been mined on the 73-foot level of the Blue Jay shaft from a vein with same strike and flat dip of Boomer vein. The Blue Jay is 500 feet to the south.

Bedrock is soil covered in most areas near the mine, so an exploration program of bulldozing trenches has been carried out in the search for other veins. A bertrandite-bearing vein has been located in this manner 200 feet north of the main shaft. A 10-ton truck load of surface ore settled at 5.0 percent BeO.

Indications point to extensive mineralization in this Badger Flats district and the U. S. Bureau of Mines has searched for veins by bulldozing and drilling. Other known beryl prospects in the district are the Tennessee a mile east of the Boomer, the Mary Lee south of the Tennessee, the J. S. 1,000 feet northwest of the Boomer, and the Redskin 2.5 miles to the northeast. The latter is entirely in the Pikes Peak granite.

Berylometer Positively Identifies All Beryllium Minerals

Several beryl showings have been found near the main shaft by using a berylometer. This new portable field instrument makes use of a well known nuclear reaction to detect beryllium and to make a fast and fairly accurate determination of the amount of beryllium in rock. The instrument is actually a scintillation counter with a phosphor which has a high neutron-to-gamma ratio. Radioactive antimony 124, produced and sold under license by the United States Atomic Energy Commission, is the source of gamma radiation. This radiation causes emission of photo neutrons from beryllium minerals which are picked up and recorded with an impulse counter. Beryllium minerals are the only ones that emit neutrons under this bombardment so the instrument is a positive means of identifying only such minerals.

Care must be taken in use of the instrument because of the dangerous gamma rays emitted. Lead shielding and distance to operator make its use safe, however. It was invented by Professor George M. Brownell, chairman of the Department of Geology at the University of Manitoba, Winnipeg, Canada, and associates. Cost is about $1,700.

With much low-grade beryllium ore left in the mine and on the dump, the U. S. Beryllium Corporation is doing research on methods to separate or upgrade the beryllium minerals.

Beryllium minerals at Mount Wheeler are found in a metamorphosed limestone bed where scheelite has been located in commercial amounts. Phenacite, the beryllium silicate, has been identified and there is perhaps another beryllium mineral. The less common minerals are often colorless, uncrystalline, and finely disseminated so that positive identification is most difficult without the berylometer.

Thus, the occurrence and geological environment of beryllium becomes better known. The long-held belief that it occurred only in pegmatites or in country rock adjacent to pegmatites is no longer valid. The prospector has new places to look and should check every high temperature vein or contact metamorphic deposit containing tungsten, topaz, fluorite, or tin. END

LOW-GRADE beryllium ore, 3.5 to 5.0 percent BeO, is backfilled in this Boomer mine stope. Recent flotation developments should make this low grade economical to mine and mill.

BERYL-BEARING Blue Jay vein in Park County, Colorado. The black arrows show foot and hanging walls, respectively. A regular hexagonal beryl crystal is circled in center.

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PRODUCTION EQUIPMENT PREVIEW

For data on any item on next three pages use the inquiry card opposite page 50

Caterpillar Enters Wheel Loader Field With High-Lift, Long-Reach Unit

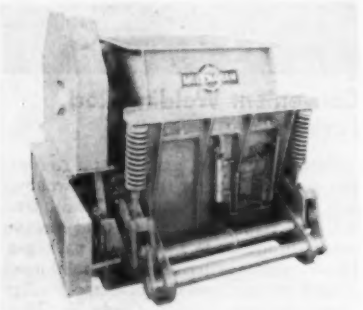
Most apparent feature of Caterpillar Tractor Company's new front end loader, which is mounted on rubber tires, is the location of the lift arms and hydraulic cylinders ahead of the operator's compartment. This is a major safety factor according to company spokesmen.

Called the Cat No. 944 Traxcavator, the new wheel loader is fitted with a 2 cubic-yard capacity bucket as standard equipment. The unit can be powered by either a gasoline or Diesel engine, both of which are rated at 105 net horsepower. The maximum rating of the D330 Diesel engine used in the No. 944 is 135-horsepower.

Dumping reach of the new Traxcavator is said to be outstanding. It totals 31.75 inches at maximum height. The maximum dumping height is 9 feet 1.87 inches. This combination of reach and height reportedly permits precise and fast-load spotting when dumping into trucks or other vehicles. Front tires of the No. 944 are the fartherest forward portion of the machine frame. This feature helps to eliminate the risk of damage to truck bodies by contact when loading. For load handling, the bucket is provided with a tip-back angle of 41° at ground level. Tip-back at maximum lift is 50°.

High productive ability of the new machine is said to result from the combination of power shift transmission, which permits split-second shifting into forward or reverse gear; a new design, high-capacity hydraulic system that delivers full hydraulic power during critical loading phases; and a high degree of stability in all conditions.

The power shift transmission is a two-speed forward, two-speed reverse, planetary transmission. The power train consists of four in-line gear trains each with a separate clutch. Hydraulic power for control of the loader comes from a 40 gpm, vane-type pump driven from an accessory drive direct-connected to the engine. Circle No. 13.



Improved Two-Stage Crusher

A special modification of the McLanahan triple-roll crusher has been developed for very high production operations. New automatic toggles protect against tramp iron . . . rolls now are gear driven . . . and models with larger size rolls are now available. McLanahan two-stage triple roll crusher is composed of two basic elements. A single roll crushes primary feed against a curved crushing plant; a double roll below performs the secondary reduction. Tramp iron protection is provided by a shear bolt in the center of the torsion bar at the rear. Unit is made by McLanahan & Stone. Circle No. 1.

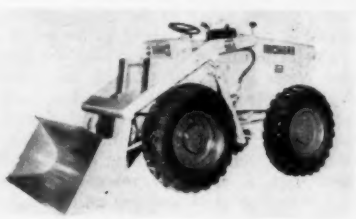
Mine Conveyor Operates a Week Without Being Moved

Hewitt-Robins, Inc. has developed a new extensible mine conveyor which can operate as long as a week or more without being moved, thereby reducing "down-time" associated with conventional conveyors which must be moved frequently to keep pace with continuous mining machinery.

The new unit is designed for use in underground mining. It is comprised of a belt which rides on idlers mounted on sled-like skids spaced at five-foot intervals. The skids are held in alignment by wire ropes. A conveyor may be constructed with as many as 200 skids, making a unit 1,000 feet long. The equipment is located behind the mine loader which receives material from the continuous mining machine. An electro-hydraulic tractor with crawler traction is attached to each end of the conveyor, exerting constant tension on the belt to keep it taut. A traveling tripper permits variation in the distance from the conveyor loading point to discharge. Material can be handled at a rate of 400 tons per hour for 70 hours or more without moving the equipment. When a mine face has advanced beyond the conveyor system's limit, the tractors tow the entire unit in long sections to a new work area. The skids supporting the idlers are designed so they will pivot on curves. Much like beads on a string, the sleds tend to track after each other in going around corners. In addition to its function of pulling the conveyor unit and carrying the tripper, the versatile tractor can be used as a general purpose vehicle for various hauling and lifting jobs in the mine. Circle No. 18.

Tractor Shovel

A new 26 mile-per-hour, one-cubic-yard tractor shovel has been developed by Clark Equipment Company. The loader features four-wheel drive, is equipped with a 66.5-horsepower gasoline engine, and has a working weight of 10,500 pounds. It is said to be capable of carrying up to 7,000 pounds. Circle No. 54

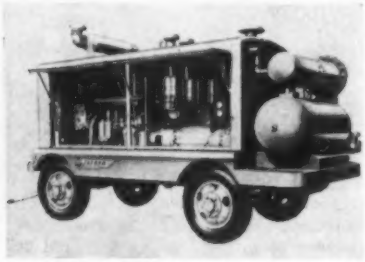


Submersible Pump

The "Hazleton-Pleuger" line of submersible pumps is constantly expanding. The pumps are manufactured by Barrett, Haentjens & Co., in Hazleton, Pennsylvania under an agreement with Pleuger Submersible Pumps of Hamburg, Germany. The motors are supplied by Pleuger. The pumps are available in acid resisting bronze or stainless steel construction in sizes from 25 hp through 500 hp.

The motors are water filled and not dependent on seals to keep the pumped liquid out of the motor.

The cut shows a unit recently placed in corrosive mine water service. The pump discharges 2500 gpm and is driven by a 200 hp, 1770 rpm, 440 volt motor. Circle No. 4



Jaeger 900 Cfm Compressor

After 9 months of field testing, Jaeger has introduced a rotary air compressor which delivers 900 cfm of air at an operating speed of only 1700 rpm. It is powered by the Model 6-110 G.M. Diesel engine which, in other compressors, is operated at 1800 rpm full load speed. The reduction of 100 rpm in engine speed results in a fuel factor of more than 500 cfm of delivered air per pound of fuel consumed. Engine and compressor wear are also reduced.

Close automatic regulation of engine and compressor maintain 100 psi minimum air pressure under all normal demand. Engine speed modulation is smooth and stepless and positively prevents any over-run or racing. Stopping and starting require only the half-turn of a regular crank. Standard equipment includes two-pass exhaust muffler, automatic blow-down valve, swing-type check valve, copper tube finned multi-pass oil cooler, hour meter, adjustable radiator shutters, wrap-around bumpers, automotive steering axle, lifting bail and hand-hold and step for easy filling of radiator. Circle No. 7

Miniature Seismograph

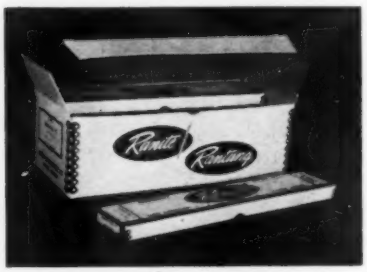
Reliable cost estimates without costly drilling are made available to mining engineers obtaining subsurface information with a miniature engineering seismograph. Manufactured by Geophysical Specialties Co., the patented 16-pound electronic instrument provides complete information for precisely determining depth to bedrock, the presence or absence of bedrock or other solid materials.

Operation of the instrument requires only two men and can be handled on foot in any type of terrain. In using the machine, seismic impulses are produced by a sledge hammer. An electronic counter circuit measures the time required for sound waves to travel from the blow of the sledge hammer through the earth to the instrument. Depth and type of material are determined with the instrument readings. Normal depth determinations can be run in 10 to 20 minutes. Under ordinary conditions, profiles can be completed at the rate of three-quarters of a mile per day at a station interval of 200 feet. Circle No. 12

Most Powerful I-H Tractor

The new TD-25 is available in either a torque converter or gear drive version reports International Harvester Company. It is powered by International's DT-817 turbocharged, six cylinder engine developing 230-net-horsepower.

Features of the tractor include: heavier, reinforced track frames of "box-within-a-box" construction; large reservoir track rollers with cartridge type seals; and IH's Planet Power system. Circle No. 57



Convenient Welding Rod Package

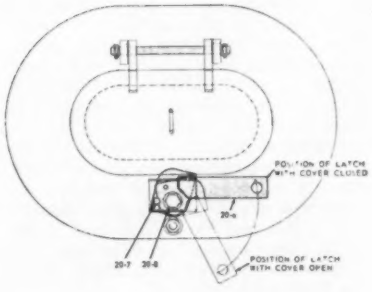
Rankin Mfg. Co., announces a convenient new package for three of its welding rods. In the future, Ranite No. 4 acetylene rod, and Rantung acetylene and electric rods will appear in five pound packages. These cartons have steel reinforced corners and are available in attractive fifty pound shipping cartons. Circle No. 15

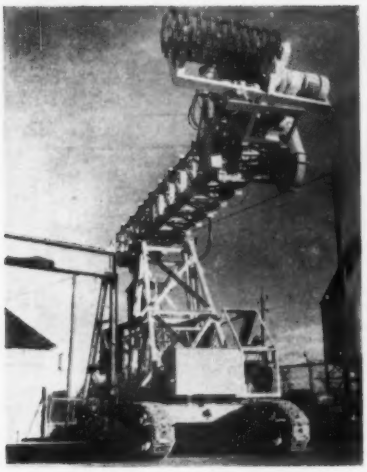
Quick-Opening Manhole Cover Designed for Easy Dumping of Ball Bill Load

A quick-opening manhole cover has been designed by Allis-Chalmers engineers which permits dumping a grinding-mill load for speedy and efficient maintenance servicing. Converting a ball mill's regular cover to the quick-opening manhole cover is reported to be simple.

First, the mill is stopped with the regular cover in top position by means of the manhole positioning control selector switch. On removal of the regular cover and liner, the quick-opening manhole cover is attached to a hinge on the mill shell with a pin. The release latch is locked and secured, and the mill brought up to operating speed.

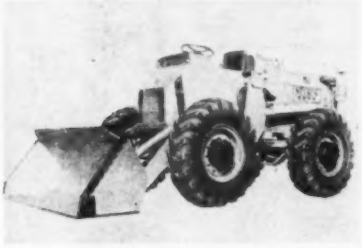
Next, the mill is stopped with the manhole in the bottom position. A chain or cable lanyard at least 50 feet in length is attached to the release latch. The latch locking bolt is removed and the latch pulled to release the cover and discharge the grinding media. After maintenance servicing, the quick-opening manhole cover is removed. The regular cover is then replaced and secured with manhole crabs. The quick-opening cover is designed only to service the mill and is not a continuous duty or normal operating device. Circle No. 3





New Idea in Roof-Scaling

Here is a photo of a new type machine for roof-scaling. Built by the Landis Steel Co. to trim scale from the high back of a salt mine, the electrically powered unit, features a two-section telescopic mast, which can extend to a height of 54 feet. The scaling device at the end of the telescopic mast consists of a rotating drum with attached flailing chains. The peripheral speed of the flailing chains is 1,400 feet per minute. The unit is expected to go into operation shortly. Circle No. 19.



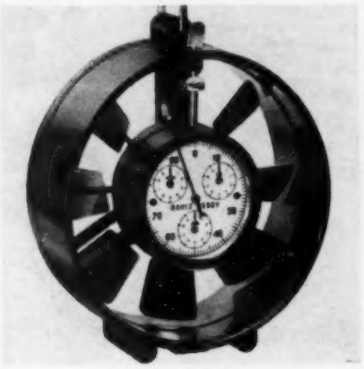
New Tractor-Shovel

The N. P. Nelson Iron Works announces the addition of the Model "150," 1¾ cubic yard capacity, to their Tractor-Shovel line. This new Tractor-Shovel, with Nelson Power-Balance, has been designed and built for extra heavy duty work with maximum speed and working efficiency.

Some of the Model "150" features are the following--Nelson underslung arms with 100% operator visibility and safety. 40° tipback bucket at ground level. Maximum dumping height, under bucket edge, of 9'0". Forward reach at 7' dumping height is 5'2". An Allison Torqmatic full reversing transmission with 3.5 to 1 stall ratio. 3 speeds forward and reverse ranging from 3.3 to 27 M.P.H. 4-Wheel drive Timken-Detroit Planetary Axles with torque proportioning differential to give maximum traction. Complete set of gauges on dash panel include tachometer and hydraulic system pressure as standard equipment. The Model "150" is powered by a Hercules G-298H, 107 H.P. Circle No. 8.

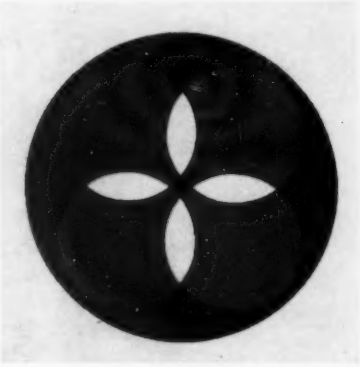
New Indicating Transmitter

A new line of pneumatic indicating transmitters for pressure, flow, temperature, liquid level, differential pressure, and dew point has just been introduced by The Foxboro Company. The new line features measuring elements specifically designed for each major process variable. The model 45 is said to have great ambient temperature stability, with less than 0.5 percent error for ambient temperature changes as great as 50° F., regardless of the variable measured. Circle No. 2.



Air Flow Instruments

A new line of Davis ventilating flow instruments is intended chiefly for measuring air velocity in mine airways. Several models are available covering ranges from as low as 30 feet-per-minute to 6,000 feet-per-minute. Made by Epic, Inc., the instruments are said to be highly accurate, handy to use, light and precise. Several extension handles up to 5 feet are available as extra accessories. Instruments come in leather or aluminum case. Circle No. 10.



Solar Prism for Transits

Manufacturing and distribution rights to a new solar prism, said to greatly simplify solar observations by transit, have been obtained by Wild Heerbrugg Instruments. Developed in Holland by Professor Roelofs, the prism fits over the telescope objective of a transit or theodolite. The prism produces four overlapping images of the sun, leaving a center area free. The telescope is then sighted to the center of the sun. Circle No. 9.

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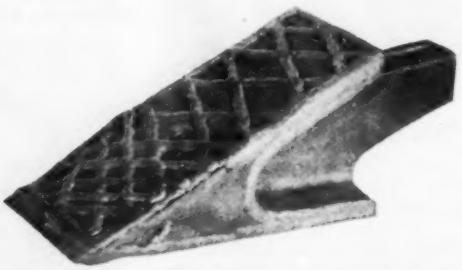
Two passes on manganese steel; as deposited—18 Rc; as work-hardened—48 Rc.



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MORE NEW EQUIPMENT . . . AND NEW LITERATURE

GUAR GUM: Structure, physical, chemical and handling properties of Jaguar, a processed guar gum made by Stein Hall & Co., Inc., is outlined in a 16-page bulletin. Reagent is used as filter aid, thickening aid and in flotation. Circle No. 58.

AUTOMATIC WELDING: Two new automatic units have been placed on the market for use with Air Reduction Pacific Company's Heliweld (tungsten-inert-gas) welding process. Of new design, they are electronically controlled. Circle No. 59.

NEW DETECTOR determines differentials in wheel speeds over the entire speed range of a Diesel-electric locomotive. The adhesion loss detector was developed by General Electric Company to provide a warning before damage occurs. Circle No. 60.

FLOW INSTRUMENTS intended for measurement of air velocity in mine openings are available in several models, covering ranges of 30 feet-per-minute to 6,000 feet-per-minute, from Epis, Inc. Circle No. 61.

MOTOR REDUCERS for use with blowers, compressors, conveyors, cranes, hoists, elevators, etc. are described in a 28-page catalog by Philadelphia Gear Corp. Both vertical and in-line reducers are covered for applications up to 125 hp and output speeds of 9 to 420 rpm. Circle No. 62.

NEW CORE DRILL has a capacity of 4,500 feet using an AX (2-inch) bit and features a hydraulic drill head and a new patented automatic chuck. Made by Acker Drill Co., the Presidente drill has a power operated air brake and clutch. The unit can be skid or truck mounted. Circle No. 63.

MINING CHEMICALS: New booklet by American Cyanamid Company summarizes latest developments and descriptive data for 13 reagents, including promoters, frothing, anti-precipitating, film-forming and carbon control agents for cyanidation. Circle No. 64.

SCRAPER BULLETIN points out speed, power and agility features of the 28-yard, 360-hp., Model B Tournapull made by LeTourneau-Westinghouse. Largest in the L-W line, special features regarding available engine and transmission combinations, and the Power Transfer differential which automatically transfers power to the wheel with best footing are described. Circle No. 65.

VIBRATING DRYERS and coolers of both the direct and indirect type are covered in a comprehensive 32-page book by Jeffrey Mfg. Co. Catalog 953 details drying principles and describes auxiliary equipment. A pilot unit rental system for test work is also described. Circle No. 66.

PYROMETER CALIBRATING SET said to permit accurate and simultaneous calibration of any two optical pyrometers regardless of make is now available from Pyrometer Instrument Co., Inc. Packaged unit is ready to use and is equipped with suitable holders and brackets for mounting of different types of optical pyrometers. For data on Pyro Model No. 107 calibrating set, Circle No. 67.

UNUSUAL TIRE is claimed to have "go-anywhere" characteristics. Made by Goodyear Tire & Rubber Company, the unique Terra-Tire is a cylindrical tire with applications as a mining equipment carrier. Because of its broad bearing surface which reduces ground pressure per square inch, Terra-Tire equipped vehicles can travel over marshes, swamps, etc. Circle No. 32.

NEW TRACTOR SHOVEL mounted on rubber tires has been developed by Pettibone Mulliken Corp. Model PM-440 has a lifting capacity of 21,000 pounds, a breakout force of 24,800 pounds, and is furnished with buckets of three to 4.25 yards capacity depending on weight of material handled. Circle No. 33.

PORTABLE ELECTRIC PLANT powered by gasoline engine and featuring an automatic idling control designed to reduce noise and fuel has been developed by Winpower Manufacturing Company. Circle No. 34.

NEW VOLTAGE REGULATOR of magnetic-amplifier type has no tubes or other parts requiring periodic warm-up. Made by Fidelity Instrument Corp., the unit may be used to regulate output voltage of any 50 to 60 cycle generator or excitor requiring a DC field supply of up to 1.8 amps at 125 volts or less. Circle No. 35.

SHOVEL CABLE that contains patented rubber cores which cushion the ground wires and help prevent breaks are described in Bulletin DM-5818. It is available from Anaconda Wire & Cable Co., 25 Broadway, New York 4, N. Y. Circle No. 14.

JAW CRUSHERS that feature curved jaw plates, forged steel swing jaw shaft and patented swing shaft suspension are described in Bulletin No. 5105 by Traylor Engineering & Manufacturing Division of Fuller Company. Circle No. 17.

ROCK BITS: Brunner & Lay 200 and 400 series tungsten carbide tipped bits are reported to be well adapted for medium longhole drilling of 20 to 30-foot blastholes. Gauge sizes range from 1⅞ to 2¾ inches in ¼-inch increments. Circle No. 20.

WOOD TANKS & PIPE: Fluor Products Company has released three new bulletins on wood tanks and wood pipe. Bul-

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letin B-145 describes wood tanks and Bulletins P-56 and WP-100 deal with wood pipe. Recent installations make use of polyethylene tubing for hoop and lug protection. Circle. No. 21.

AIR FLOW INSTRUMENTS intended for measuring air velocity in mine airways are available from Epic, Inc. Available models cover ranges from 30 to 6,000 feet-per-minute. Unit is said to be highly accurate. Circle No. 22.

FRONT END LOADER: Crawler mounted unit made by Eimco Corp. (Model 126) is said to be most powerful loader made today, with 205-horsepower teamed with Eimco's "Unidrive" transmission, single stage torque converter and dual final drives. Circle No. 23.

TESTING ASBESTOS FIBER: New booklet describes in detail 19 basic property tests that can be used for evaluation of asbestos fiber. It is available through American Smelting and Refining Company and its subsidiary, Lake Asbestos of Quebec, Ltd. at 120 Broadway, New York, N. Y. Circle No. 24.

NEW SOLAR PRISM, easily attached to telescope objective of a transit, produces four images of the sun, leaving free a center square. The telescope is than sighted to the center of the sun, greatly simplifying solar observations since reductions to the center are eliminated. Unit is available from Wild Heerbrugg Instruments, Inc. Circle No. 25.

TURRET DERRICK is a new construction and maintenance tool mounted on a truck by Truck Equipment Company. Unit is said to be three tools in one—a derrick, a digger and an aerial lift. Circle No. 26.

AIRLEG DRILL made by Atlas Copco is said to be fast and easy to handle. Newest model is called the Tiger and it features a retractable airleg, convenient controls and automatic back head. For details write Atlas Copco Eastern or Atlas Copco Pacific Dept. MW-10. Circle No. 27.

AIR SEPARATOR: Bulletin No. 057 by Sturtevant Mill Company describes dry classification units, capable of handling large circulating loads. Circle No. 28.

MATERIALS HANDLING: Engineering Catalog 59-A by National Iron Company contains photos, detailed drawings, diagrams, engineering data and specifications for heavy duty feeders and conveyors. Circle No. 29.

COOLERS of both the horizontal-grate and inclined-grate type, as well as a Clinker Breaker designed to work with them, are discussed in an 8-page bulletin by Fuller Company. Circle No. 30.

DRY SEPARATOR, which operates on an electromagnetic principle and offers a capacity up to one ton-per-hour, has laboratory applications. Made by S. G. Franz Co. Inc., the Model 48-V consists of stacked, 4-grids that are magnetized by a DC coil. Sloping vanes on grids divide and retard flow of material. Circle No. 31.

NEW HYDRAULIC RAMS of single-cylinder, single-acting type have been developed by Owatonna Tool Company, 626 Cedar Street, Owatonna, Minnesota. Nine sizes are available, from a ram only 1 11/16 long with ¾-inch stroke to a 20¾-inch ram with 13⅛-inch stroke. Circle No. 52.

SPECIALIZED LUBRICANT for air tools cut maintenance costs on four hand held rock drills $200 since introduction at a quarry operation, reports Keytone Lubricating Company. Lubricant used was Keylubric, which is said to provide high film strength and stability. Circle No. 53.

TRACK TURNOUT DATA: A four-page folder offers data on various turnouts and curves from main track. Issued by Bethlehem Steel Co., a table and diagram shows distances from point of frog to point of intersection and from point of intersection to point of tangency for crosscuts at angles of 20, 30, 45, 60 and 90°. Circle No. 55.

PUMP DRIVES: A new line of variable speed magnetic drives designed expressly for pump applications and matched to fit standard vertical motors has been announced by Electric Machinery Mfg. Co. Drives are air-cooled and an automatic speed control circuit is part of the drive package. Circle No. 36.

ENGINE MAINTENANCE: A new 24-page booklet related especially to Diesel engines describes 10 maintenance steps. It's been prepared by Cummins Engine Company. Circle No. 37.

OFF-HIGHWAY TRUCK, featuring 19-ton capacity Model 65 Payhauler of International Harvestor Co. is described in a new 16-page catalog. Model 65 unit has a corrugated body said to make possible a 5,000-pound reduction in body weight. Circle No. 38.

CAR SHAKER LEAFLET has been released by Allis Chalmers Mfg. Co. It describes a 3½-ton unit said to provide safe, economical, pushbutton unloading of material from open, bopper-bottom gondolar cars. Circle No. 39.

DUROLITE BLOCK measuring 8 inches in diameter and which will take 1-inch dacron, nylon, manila or polyethylene rope is now available from Sauerman Bros. Inc. Circle No. 40.

CONTROL PANELS for a wide variety of automatic materials handling systems are discussed in a 12-page bulletin offered by Fuller Company. Four basic types are described and applications in taconite processing and cement processing are outlined. Circle No. 41.

CYANAMID FLOCCULANTS are the subject of a 20-page bulletin of technical notes prepared by American Cyanamid Company. This comprehensive booklet should be added to the files of metallurgists. Circle No. 50.

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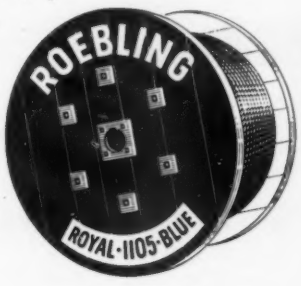
When you're talking about a $162,000 dipper shovel, you've got to talk about the best rope for it



Talking about or working with, the same thing applies. Anything below Royal Blue's performance level is simply unrealistic. Like looking for a cut-price brain surgeon.

Even at $162,000, the cost of wire rope is important. That's why so-so ropes can cost you more in the long run, because so-so ropes are *short run*. Royal Blue, on the other hand, is built by America's oldest manufacturer of wire rope to last, to do the job without a whimper. Here's why.

Royal Blue is made from the toughest rope wire ever made—Type 1105—extra high-strength improved plow steel. This pedigree gives to the rope qualities that you can't find in any other rope: exceptional resistance to shock, abrasion, fatigue and impact. Add to these a flexibility that age cannot wither nor hustling fade and you've got a collection of characteristics that make Royal Blue the strongest rope you've ever used.

A $162,000 Dipper Shovel deserves the best and your Roebling Distributor has it . . . Royal Blue. For information, write to Roebling's Wire Rope Division, Trenton 2, N.J.

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Branch Offices in Principal Cities

John A. Roebling's Sons Division • The Colorado Fuel and Iron Corporation

UPGRADING AND SHARP CLASSIFICATION WITH KREBS INTEGRAL 2-STAGE CYCLONES*

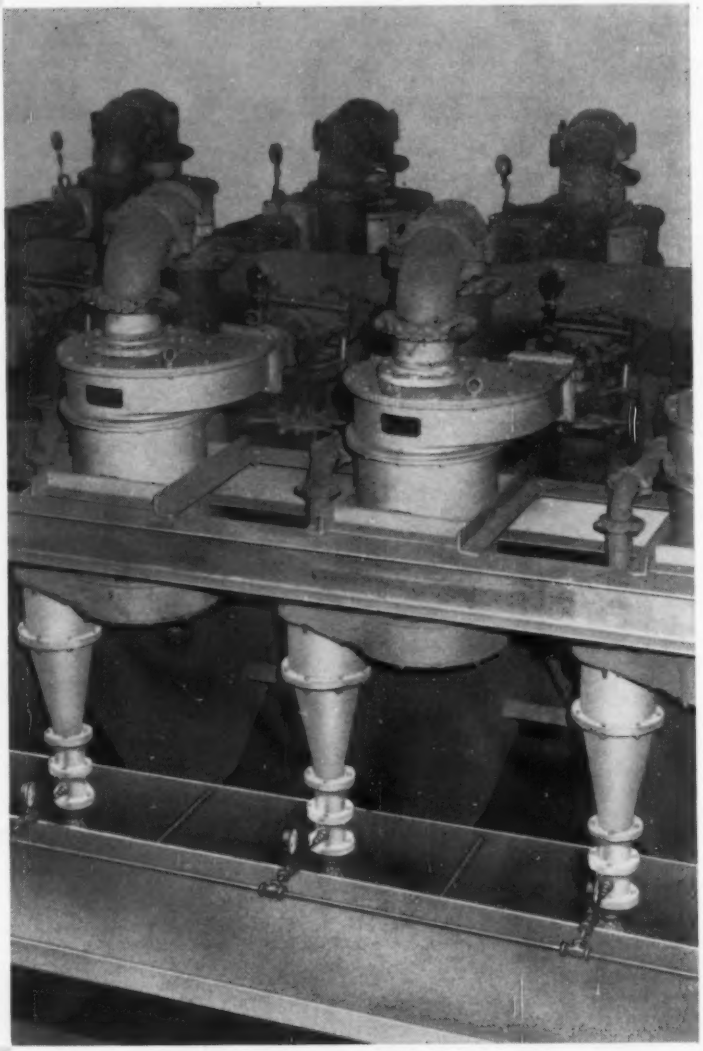
The three-products feature of this cyclone design creates profits by upgrading ores of iron, chrome, manganese, copper, gold, glass-sand, alumina, and other industrial minerals. The Krebs integral two-stage cyclones are a standard method used ahead of spirals for upgrading in iron washing plants—see photo.

Applications are diverse. A copper concentrator uses them on full tonnage, rejecting an essentially minus 15 micron slime from the primary cylinder, with the secondary overflow being the flotation feed, and the small tonnage of underflow reground and recycled.

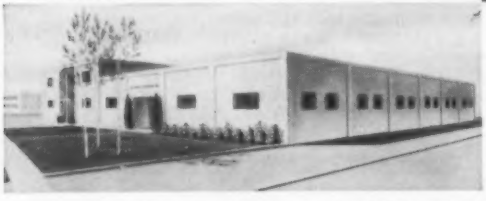
While most of the 20 Models and the vast majority of Krebs Cyclones in operation are single-stage, 70 plants have installed the two-stage cyclones to obtain the most efficient upgrading.

This is only one of many Krebs Cyclone design developments in the past 10 years. Recent work indicates even wider applications and economic advantages with the Krebs integral two-stage cyclones.

Where upgrading or a sharp classification may be significant to your operations, we invite you to make use of our Pilot Plant facilities and staff of cyclone specialists.



*Patented



EQUIPMENT ENGINEERS INC.

737 LOMA VERDE AVENUE · PALO ALTO, CALIFORNIA

SPECIALIZING EXCLUSIVELY IN CYCLONE TECHNIQUES

MEN WHO MAKE NEWS IN U.S.

H. CARROLL WEED

NORMAN WEISS

WOODROW LAIR

C. B. PREBICH

H. J. LEACH

V. L. MATTSON

H. Carroll Weed of Inspiration, Arizona, has been elected a director and vice president of Inspiration Consolidated Copper Company. He will continue as general manager of the company. **H. Myles Jacobs** has been elected president of Inspiration at its New York, New York headquarters. He succeeds **Pharic D. I. Honeyman,** MINING WORLD's 1957 Man of the Year, who is retiring.

Norman L. Weiss of Salt Lake City, Utah, is this year's selection for the AIME Robert H. Richards award, presented during its annual meeting in New York last month. Mr. Weiss, milling engineer with American Smelting and Refining Company, was honored in part for his ". . . development and application of differential flotation and cyanidation to complex base and precious metal ores . . . ."

Fred W. Strandberg, chief mining engineer for the Anaconda Company in Butte, Montana, has retired after 43 years in the mining field. **R. Davidson Piper** has been promoted to succeed him and **John F. Harvey** to take Mr. Piper's former position as assistant chief mining engineer.

John Kochevar of Hibbing, Minnesota has been named by Pickands Mather & Co. as master mechanic at the Mahoning iron mine at Hibbing on the Mesabi range. He replaces **William O'Connor,** who has retired.

Charles E. Pregenzer has been selected to fill a new position, haulage and ventilation foreman, in the Carlsbad potash mine of International Minerals & Chemical Corporation. Mr. Pregenzer joined the company in 1951, serving in various departments including the storage and loading department, where he has been supervisor since 1956. Another personnel change for the corporation is the promotion of **J. F. Hollerbaugh** to be manager of planning in the agricultural chemicals division. Formerly production manager of the phosphate minerals and chemicals operations, Mr. Hollerbaugh has been on the Florida staff of the company for 18 years.

In reorganizing its metallurgical research department in Anaconda, Montana, The Anaconda Company has named three assistant directors to head three major departments, with **Francis L. Holderreed** as director of the entire program. The assistants are **Robert E. Sullivan,** chemical division; **Theodore G. Fulmore,** concentration division, and **W. Harold Foard,** pyrometallurgical division.

Woodrow W. Lair has been promoted by United States Borax & Chemical Corporation to be refinery superintendent at its potash refinery near Carlsbad, New Mexico. Formerly assistant superintendent there, Mr. Lair has been with the company since 1946.

Charles B. Prebich has been advanced to the position of superintendent, mechanical maintenance department, at the Babbitt Division, Reserve Mining Company, in Silver Bay, Minnesota. A Reserve employee since 1954, Mr. Prebich has recently been superintendent of the Babbitt Division's mechanical maintenance department.

Dr. Ronald J. P. Lyon, formerly associated with the Kennecott Research Center in Salt Lake City, Utah, has assumed the position of senior geochemist with the Department of Earth Sciences, Stanford Research Institute, Menlo Park, California. Dr. Lyon will be directly responsible for the development of research programs in geochemistry, particularly as applied to problems of ore genesis, mineral processing, and mineral exploration.

Bernard J. O'Neill, Jr. has joined the staff of Stanford Research Institute, Menlo Park, California, as a geologist, where he will be assigned to a study of the geology and hydrology of San Clemente Island. Mr. O'Neill was formerly with the New Jersey Zinc Company, where he was concerned with the application of geology, geophysics and geochemistry to explorations for zinc and allied metals.

R. W. Livingston, ore dressing engineer for the Minnesota Ore Division, Jones and Laughlin Steel Corporation, Calumet, Minnesota, has resigned his position after many years on the Minnesota Iron Range to accept a similar post at Duval Sulphur and Potash Company, Tucson, Arizona.

James H. Polhemus, assistant superintendent of the Milling Department, American Zinc Company of Tennessee, Mascot, Tennessee, will become superintendent of that department to succeed **D. B. Grove,** who has retired. Mr. Polhemus came to Mascot in 1943, following his graduation in mining engineering from Rolla School of Mines, Missouri. **James P. Snider,** metallurgist, formerly an ore dressing engineer with the Jones and Laughlin Steel Corporation at Calumet, Minnesota, will succeed Mr. Polhemus as assistant superintendent.

Hugh J. Leach has been promoted by The Cleveland-Cliffs Iron Company to be vice president for foreign operations and iron ore development. Manager of Michigan iron ore mines for the company since August 1958, Mr. Leach will be succeeded in that position by **Harry C. Swanson,** formerly general superintendent of Cleveland-Cliff's mines in Michigan.

Vernon L. Mattson, manager of mineral development and research at the Golden, Colorado, research laboratories of Kerr-McGee Oil Industries, has been named manager of mining and milling at the company's home office in Oklahoma City, Oklahoma. Mr. Mattson joined Kerr-McGee in 1955, after being director of the Colorado School of Mines Research Foundation and associated with the Consolidated Feldspar Corporation. His successor at the Golden laboratories will be **Wayne C. Hazen,** previously research engineer there.

Robert M. Grogran has been named to succeed **Joseph L. Gillson** as chief geologist of the DuPont Company's development department. Dr. Gillson, who has won national recognition in his profession and was recently inaugurated as national president of AIME, retired last month after more than 30 years with DuPont. Dr. Grogan, who will head a development department, joined DuPont in 1951 after affiliation with the Illinois State Geological Survey and as a consultant to various organizations.

George Kromen, general superintendent of the Fairmont City, Illinois plant of the American Zinc Company of Illinois, has been promoted to the position of plant manager. He joined the organization in 1947 and was promoted to assistant general superintendent in 1951, and to general superintendent in 1955.

Oscar A. Glaeser, vice president and general manager of western operations for the United States Smelting, Refining and Mining Company, has been elected president of the Utah Mining Association to succeed **Lockwood W. Ferris. S. K. Droubay,** vice president and general manager of United Park City Mines Company, has been elected first vice president; **F. C. Green,** general manager of Utah Copper Division, Kennecott Copper Corporation, was named second vice president; **Mitchell Melich,** president of Uranium Reduction Company, has been elected third vice president. **Miles P. Rommey** was re-named secretary and manager, and Walter M. Horne, assistant secretary and manager.

OBITUARIES

HOMER A. MANN
An Appreciation
by
Weston Bourret

The many friends of Homer throughout the mining world will be saddened to learn of his tragic death in a plane crash near Minersville, Utah on January 13, 1960. Homer's great personal charm, modesty and tremendous energy attracted people to him wherever he went; his kindliness, directness, unfailing courtesy and patience, as well as outstanding capabilities, won him recognition among all who knew him. He was without doubt one of the most capable mining engineers in the nation.

After graduation with a B.S. degree in mining from the University of California in 1935, he started his career with the Masbate Consolidated Mining Company, in the Philippines and held the position of chief engineer and assistant manager at the time of the Japanese attack on Pearl Harbor. He succeeded in getting to Cebu and joined the guerrilla forces under Colonel Peralta in January of 1943.

Homer returned to the Philippines in 1947 with his former employer, Colonel Andres Soriano; there he continued his mining career and was appointed consulting engineer in the Manila office of International Engineering Corporation and its affiliated companies.

During the Korean War, he returned to the United States, this time permanently, and came to Washington, D. C. where he worked for two years with DMPA as chief of the Rare Metals Branch. In Washington he is well remembered for his energy, competence, and sound judgment in the Strategic Metals program. He joined Utah Construction & Mining Company as an executive in the Exploration Department in 1953 and played a major role in the development of that company's uranium, coal, and iron ore properties. His creative mind, thoroughness and outstanding grasp of the mining business contributed tremendously to Utah's success in developing new mining operations. He possessed an uncommon knowledge of all phases of mining through exploration, development, and operations and was particularly gifted as a negotiator because of his fairness, consideration, and patience. Though gentle with people, he possessed great strength of character and stature as a man; he was highly respected and trusted wherever he went. At the time of his death Homer was manager of mining services for Utah Construction.

His passing will be deeply felt not only by his closest friends, his wife Helen Marie Mann, daughter Mary Elinor, and son Robert, but also by all those privileged to work closely with him.

GEORGE WINGFIELD
An Appreciation
by
The Nevada Mining Indutsry

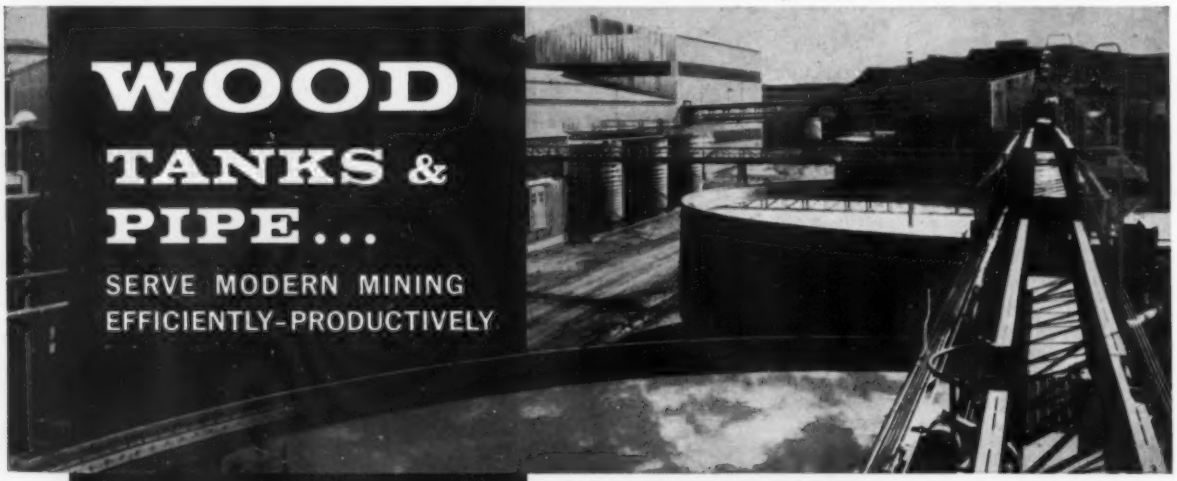
As it must to all men, death came to George Wingfield Christmas night, December 25, 1959, at the Washoe Medical Center in Reno, Nevada.

In the spring of 1901, he followed the gold rush to southern Nevada and became a resident of Tonopah, where he was engaged in various business ventures and mining until 1903, when he moved to Goldfield. In 1906, in association with the late Senator George Nixon, he organized the Goldfield Consolidated Mines Company, which was a consolidation of five of the most important mining companies in the Goldfield district. The consolidation was effected in order to avoid what would have been prolonged litigation over extra-lateral rights claimed by the five autonomous mining companies.

As a result, Goldfield Consolidated became one of the most important gold producers in the United States—as dividends paid by that company total about $30,000,000.

After phenomenal success in mining ventures in southern Nevada, he headed, as president, many mining companies with large production records, including the Nevada Hills Mining Company in Churchill County; the Buckhorn Mining Company in Eureka County; and the Aurora Consolidated Mining Company. In addition, the Goldfield Consolidated Mines Company owned and operated subsidiary mining companies in various areas of the West, including Arizona, California, and Washington.

He was a firm believer in private enterprise, was a generous contributor to worthwhile charities, was loyal to his friends and tolerant toward those who thought they were his enemies due to misinformation, misunderstandings, or failure to look beneath the surface. His idea of WPA was to Work, Persevere, and Aspire. He left an indelible mark upon the history of his state and it does not seem probable that anyone will ever wield the influence that he did in mining, banking, business, and politics in Nevada.



Many large mills are equipped with Santa Fe Tanks and Pipe because they recognize our long experience in solving technical mining processing problems. Recent installations include thickener tanks up to 100' in diameter with Polyethylene tubing used for hoop and lug protection.

NO CORROSION . . . NO RUST

SANTA FE PRODUCTS INCLUDE:

- Thickener Tanks
- Solution Tanks
- Agitation Tanks
- Water Storage Tanks
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- Wood Flotation Cells
- Wood Precipitation Boxes
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- Wood Stave Pipe
- Wood Stave Flumes
- Wood Flume Stacks
- Wood Scrubber Towers

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The FLUOR CORPORATION, Ltd.
Santa Fe Tanks
P. O. BOX 1267
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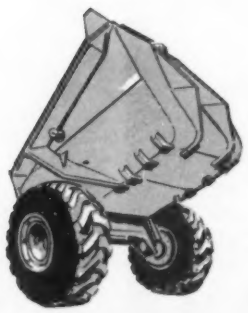
faster loading . . .
LW Rear-Dumps position fast, usually spot **under shovel** in one continuous motion. Wide top opening permits easy loading. Low rear entry speeds dipper swing, reduces spillage.

hauls anywhere . . .
Rough haul roads, uneven terrain, sticky mud is no problem for LW Rear-Dumps! Wide, low-pressure tires, exclusive power-transfer differential, balanced weight-distribution, electric-steer, all help provide go-anywhere traction.

dumps cleaner . . .
Electric motor raises tapered bowl fast and material dumps quickly. End of bowl extends beyond rear wheels for clean over-bank dumping. Electric controls permit fast dump or controlled spread. Front-wheel-drive permits easy pull-out.

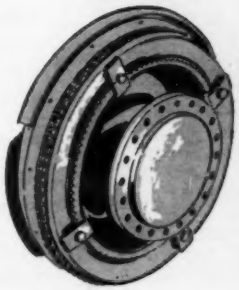
These LW Rear-Dump features serve you two ways . . .

1. bigger production
2. lower handling costs



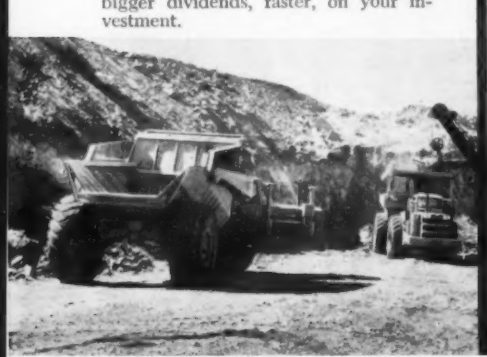
reduces maintenance . . .
Repair bills are lower, daily lube time is shorter, because LW Rear-Dumps eliminate such troublemakers as hydraulics, springs, long drive-shaft, universal joints, tie-rods, small steer-wheels, and frame.

easier operation . . .
Production stays high all day-long because many fatigue factors are reduced. Big tires, big foam-cushion seat, smooth out ride for operator. Fingertip electric-switches give speed-of-light control with little effort.



greater safety . . .
Multi-disc air brakes provide more brake surface per wheel than most haulers have on four wheels. Low center of gravity, excellent visibility, front-wheel-drive, and easy control—all increase safety.

easier to own . . .
LW Rear-Dumps are competitively-priced. Because they last longer, cost less to maintain, and produce more, your savings are substantial. They pay bigger dividends, faster, on your investment.



insure future earnings . . .
Behind same Tournapull prime-mover you can interchange scraper, crane, bottom-dump, and other trail units. With them, you can increase your work capacity for bigger year-round profit.

job-proven . . .
LW Rear-Dumps prove profitable wherever there's shovel material to be hauled. Hundreds of these versatile machines are in use in mines and quarries all over the world. Three sizes: 11, 22, and 35 tons.

Rear-Dump—Trademark RD-2232-M

LeTOURNEAU-WESTINGHOUSE COMPANY, PEORIA, ILLINOIS

A Subsidiary of Westinghouse Air Brake Company

Where quality is a habit

Only
TURBULAIRE-DOYLE
SCRUBBERS

GIVE YOU JET-ACTION GAS-CLEANING WITH NO MOVING PARTS!

The Turbulaire-Doyle Scrubber is unique in its high collection efficiencies and low maintenance requirements because it incorporates a jet-action design that assures a far more thorough scrubbing action—yet requires no complex mechanical systems that boost maintenance and repair costs.

THE JET-CONE MAKES THE DIFFERENCE!

This Jet-Cone in the throat of each Turbulaire-Doyle inlet tube causes a sharp increase in the velocity of the incoming gases—the velocity reaching maximum at the point where the dirt-laden gases impinge upon the scrubbing liquid.

RESULT: ***unusually deep penetration of gases into the scrubbing fluid for more complete cleansing of all suspended particles—even those in the fume range.***

Yet there are no moving parts—nothing to require frequent repair or replacement!

ILLUSTRATED ABOVE: Two-stage rubber-covered units remove dust and fume from gases at wet process phosphoric acid plant. Capacity: 64,000 CFM.

Compare
TURBULAIRE-DOYLE ADVANTAGES

- **HIGH COLLECTION EFFICIENCIES** generally in the 97% to 99% range.
- **FINE PARTICLE COLLECTION** even fume-range particles.
- **LOW LIQUID-TO-GAS RATIO** only 1 to 5 GPM/1000 CFM.
- **NEGLIGIBLE MAINTENANCE** no moving parts to wear or corrode—no "plugging" problems.
- **NO CORROSION PROBLEMS** simple design permits wide choice of corrosion-resisting materials.

Send for Descriptive Bulletin!

Only WP has all 6

1. COTTRELL Electrical Precipitators
2. MULTICLONE Mechanical Collectors
3. CMP Combination Units
4. DUALAIRE Jet-Cleaned Filters
5. THERM-O-FLEX Hi-Temp Filters
6. TURBULAIRE-DOYLE Scrubbers

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Engineers and Constructors of Equipment for Collection of Suspended Material from Gases . . . and Equipment for the Process Industries

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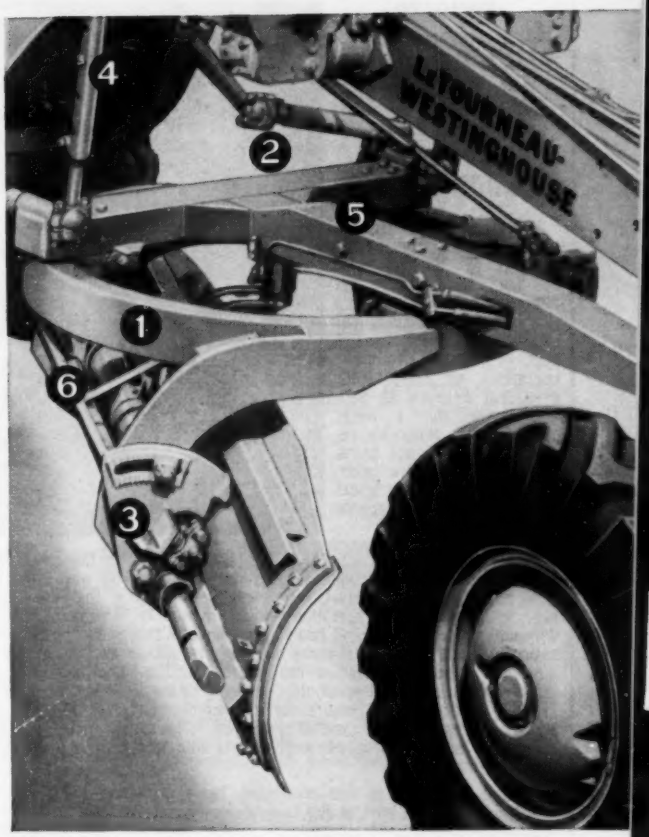
Precipitation Company of Canada Ltd., 8285 Mountain Sights Avenue, Montreal 9

fast movement, lasting accuracy, long life

The "working end" of your grader is the blade and the circle assembly that controls it. With LeTourneau-Westinghouse graders, you're set up with a system that assures you *fast* blade movement with *positive* control. Result: Your operator grades more accurately, cuts deeper, pushes more dirt faster than any similar unit. Here's why:



1 BIG 63" CIRCLE . . . none bigger in the industry . . . all-welded and precision-machined, top, bottom, and inside, turns smoothly within adjustable guides. Teeth are protected from abrasive materials.

2 ENCLOSED GEAR-DRIVEN LATERAL SHIFT . . . free from lost motion and vibration common with open-rack types, and provides rigid support to blade in all positions.

3 QUICK, EASY MOLDBOARD TILT-ADJUSTMENT . . . to change pitch of moldboard, operator loosens only one nut on each circle leg and makes desired adjustment.

4 WIDE-SPACED LIFT-LINKS — go "straight down" for stable blade control . . . strong, telescopic, they extend or retract easily, have wear-compensating shim adjustments, and enclosed ball-and-socket connections. Short, stocky lift-arms avoid springing action for greater rigidity.

5 RUGGED T-SHAPED DRAWBAR . . . offers immense strength for circle support and blade pull. "T" design permits excellent blade visibility. Drawbar has 3 adjustable circle-wearing plates.

6 UNIVERSAL MOUNTING FITS ALL MOLDBOARDS bracket, slide-shift, or power-shift moldboards can be interchanged on the *same* circle and legs.

Positive blade control is just one of the many profit-building features on the new, better-than-ever LW graders. Let us send you complete facts. 7 models 63 to 190 hp.

G-2157-G-1r

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Where quality is a habit

"FLEXIBILITY AND LOW UPKEEP COSTS MAKE FLYGT PUMPS AN ADVANTAGE," reports LUCKY FRIDAY SILVER-LEAD MINES CO. Mullen, Idaho

While working a 750' shaft-deepening project from the 2300 to 3050 foot level, the Lucky Friday Mine ran into a dewatering problem which required pumping out an average of 150 to 175 gpm. At the start of sinking operations, air pumps were used, but because of periodic extra volume water seepage and excessive repair and maintenance costs, the air pumps were abandoned in favor of Flygt Model B-80L Electric Submersible Pumps.

In the pumping cycle, a Flygt Pump was lowered to the shaft bottom as soon after each blast as possible, and the water was lifted to relay pumps at a higher level, with heads up to 80 feet. The Mine Engineer, in a paper on the operation delivered before the Northwest Mining Convention, said of the Flygt pumping method: "Although the initial cost seemed high at first, the absence of expensive upkeep and the efficient pumping performance justified the investment. The quiet operation of the Flygt was a decided relief after listening to the siren-like air pumps. The Flygt Electric Pump was a distinct improvement over any type of air pump where large volumes of water had to be moved from the shaft bottom. It was low in upkeep cost and its unusual flexibility made it a definite advantage."

Since shaft sinking was completed, two Flygt Model B-80L Pumps now have become a part of the Lucky Friday's permanent mine pumping installation. In service since October 1956, they still are performing with a maximum of efficiency and a minimum of upkeep.

Additional satisfied users of Flygt Pumps in mining applications include Climax Molybdenum Mines in Colorado, Inspiration Copper Mine in Arizona, Kermac Nuclear Fuels in New Mexico, Boyles Bros. Drilling Co. in Utah, Utah Construction Co. in San Francisco, San Manuel Copper Mine in Arizona, White Cap Gold Mining Co. in Nevada, and others.

Flygt Electric, Submersible Pumps range from 1½" 85 gpm to 8" 3100 gpm capacity. Heads to 220'. Higher heads are possible with Flygt Pumps in tandem. Ask today for literature and an on-the-job demonstration.

CHECK THESE FLYGT FEATURES

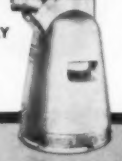
- Electric
- Resistant to Salt Water
- Submersible
- Easy to Handle
- Low Maintenance Costs
- Will Pump High Amount of Solids
- Heavy Duty
- Operates Unattended
- Runs Dry Without Damage
- Quick and Easy to Service
- No Installation Costs
- No Priming Needed

WRITE FOR NAME OF YOUR NEAREST DEALER

PUMP BETTER ELECTRICALLY

FLYGT

— USE FLYGT!



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Santa Monica, California

Metal & Mineral Prices

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METALS

February 19, 1960

COPPER: **Electrolytic.** Delivered F.o.b. cars, Valley basis (pound) ..... 33.00¢
Lake. Delivered, destinations, USA ..... 33.00¢
Foreign. Delivered, destinations, USA ..... 33.00¢
Custom ..... 35.00¢
LEAD: **Common Grade.** New York (Per pound) ..... 12.00¢
Tri-State Concentrate, 80% lead, per ton $141.72
ZINC: **Prime Western:** F.o.b. E. St. Louis (Per Pound) ..... 13.00¢
Prime Western: Delivered New York ..... 13.50¢
Tri-State Concentrate, 60% zinc per ton $80.00
ALUMINUM: **Primary 30 Pound Ingots (99.5% plus)** (Per pound) 26.80¢
ANTIMONY: **Lone Star Brand. F.o.b. Laredo, in bulk** (Per pound) 29.50¢
BISMUTH: **(In ton lots) price per pound** $2.25
CADMIUM: **Sticks and bars.** 1 to 5 ton lots Price per pound .. $1.50
COBALT: **97.99%, keg of 550 pounds (Price per pound)** $1.75
COLUMBIUM: **Powder** ..... **Nom., per pound $55.00-$85.00**
GERMANIUM: **dioxide, high purity, gram** ..... 18.50¢
LITHIUM: **98%** (per pound) ..... $9.00-$12.00
MAGNESIUM: **Ingots (99.8%)** F.o.b. Velasco, Texas per pound 36.00¢
MERCURY: **Flasks.** Small lots, New York ..... $211.00-$214.00
NICKEL: **"P" Ingots (5 pounds). F.o.b. Port Colbourne, Ontario** 75.50¢
PLUTONIUM: To July 1 1962 AEC will pay $30.00 to $40.00 per gram depending on plutonium 240 content. July 1, 1962 to June 30, 1963, per gram $30.00
SELENIUM: **99.5%, per pound** $7.00
TELLURIUM: Common grade, Per pound $3.00
THORIUM: per kilogram $43.00
TIN: **Grade A Brands.** New York (Per Pound) Prompt delivery $1.01
TITANIUM: **93.3%** + Grade A-1 Sponge (Per pound) ... $1.50-$1.60
URANIUM: **Rod** (0.790 U-235) $16.00 Per Pound; **Foil** $16.75
U-235: **Nominal** (Per pound) $7,725
GOLD: **United States Treasury Price** ..... $35.00 per ounce
SILVER: **Newly mined domestic.** U.S. Treasury price per ounce 90.5¢
Foreign Handy Harmon ..... 91⅜¢
PLATINUM: Per ounce ..... $82.00-$85.00
ZIRCONIUM: **Sponge,** Per pound, Reactor Grade $5.00

ORES AND CONCENTRATES

BERYLLIUM ORE: **10 to 12% BeO.** F.o.b. mine, Colorado $46.00 per unit
Small lot purchases at Custer, S. D., Spruce Pine, N. C., and Franklin, N. H. Visual inspection at $400.00 per short ton or by assaying at 8.0 to 8.9% BeO, $40 per unit; 9.0 to 9.9%, $45; over 10.0%, $48.00.
CHROME ORE: F.o.b. railroad cars eastern seaports. Dry long tons,
African (Rhodesian). 48% Cr_2O_3. 3 to 1 Ratio .... $35.00-$36.00
African (Transvaal). 48% Cr_2O_3. No ratio ..... $28.00-$32.00
Turkish, 48% Cr_2O_3. 3 to 1 chrome-iron ratio .. Nominal $45.00
U.S. Government ore-purchase depot Grants Pass Oregon. Buying suspended, quota filled.
COLUMBIUM-TANTALUM ORE: **Per Pound Pentoxide** Nominal $1.00
IRON ORE: **Lake Superior. Per gross ton Lower Lake Ports**
Mesabi, Non Bessemer, 51.5% Fe $11.45
Mesabi, Bessemer, 51.5% Fe $11.60
Old Range Non Bessemer $11.70
Old Range Bessemer $11.85
Swedish, Atlantic Ports, 60 to 68% Fe Contracts, Per Unit 25.00¢
MANGANESE ORE: **Metallurgical grade.** 48 to 50% Mn Long ton unit ..... $0.95-$1.00
Metallurgical grade. 46 to 48% Mn. Long ton unit ... $0.90-$0.95
Metallurgical grade. 44 to 46% Mn. Long ton unit ... $0.80-$0.85
Domestic U.S. Government. GSA Basis $2.30 per unit for 48% mn.
MOLYBDENITE CONCENTRATE: **90% MoS_2 F.o.b.** Climax, Colorado. Per pound Mo, plus container cost $1.25
TUNGSTEN CONCENTRATE: **Domestic.** 60% WO_3 **Per short ton unit** ..... Nominal $24.00
Foreign: 65% WO_3 Per short ton unit (Scheelite) ... Nominal $18.00
Foreign: South American, Spanish, Portuguese .... Nominal $17.00
URANIUM ORE. F.o.b. purchase depot or company mill in accordance with AEC schedules and company buying contracts. Basic price is $1.50 per pound of U_3O_8 in ore assaying 0.10 percent. For each additional 0.01 add 20¢. Subject to development allowance, premiums, penalties where applicable.

NON-METALLIC MINERALS

BARITE: Oil well drilling. Minimum **4.25 specific gravity,** per short ton $16.00
BENTONITE: **Minus-200mesh.** F.o.b. Wyoming. Per ton, carload lots $12.50
Oil Well grade. Packed in 100 pound paper bags $14.00
BORON: **technical grade** .. F.o.b. Boron California. Per ton $47.50
FLUORSPAR: **Metallurgical grade. 72.5 % effective CaF_2** content per short ton F.o.b. Illinois-Kentucky mines ... $37.00-$41.00
Mexican. 70% F.o.b. border ..... $26.00-$27.00
Acid Grade. 97% CaF_2, Bulk, F.o.b. mine ..... $45.00-$49.00
PERLITE: **Crude:** F.o.b. mine per short ton ..... $3.00 to $5.00
Plaster grades. Crushed and sized. F.o.b. plants .... $7.00 to $9.00
SULPHUR: Long ton, F.o.b. Hoskins Mound, Texas $25.00
Export ..... $24.00-$25.00

London

February 19, 1960

Per Long Ton USA Equivalent cents per pound*

COPPER:	Electrolytic spot	£272	0s 0d	34.00¢
LEAD:	Refined, 99%	£ 73	12s 6d	9.15¢
ZINC:	Virgin, 98%	£ 89	2s 6d	11.15¢
ALUMINUM:	Ingot, 99.5%	£186	0s 0d	23.25¢
ANTIMONY:	Regulus, 99.6%	£197	10s 0d	24.69¢
TIN:	Standard, 99.75% ..	£793	0s 0d	99.13¢
TUNGSTEN:	Long ton unit	£159s		$22.26

*With Sterling Pound at $ 2.80

Quotations on metals and certain ores through the courtesy of *American Metal Market, New York, N. Y.*

WHAT'S GOING ON IN MINING

COLORADO

New dates have been set for the National Western Mining and Energy Conference in Denver, originally scheduled for March 17, 18, and 19. The conference will be held at the new Denver Hilton Hotel April 21, 22, and 23. The 63rd conference of its kind, it is sponsored by the **Colorado Mining Association,** the **Denver Chamber of Commerce,** the **United Uranium Industry Committee** and affiliated groups.

Previously undiscovered uranium ore bodies near Gateway, Colorado, have been reported by W. D. Nebeker, Jr. of Salt Lake City, president of **Croff Oil Company,** which receives a 20 percent royalty on uranium ore produced. The mines are leased to James A. Martin of Palisade, Colorado, and qualify under the ore reserve program established by the **Atomic Energy Commission** for the Uravan mineral belt. New reserves are in the **Corvusite, Black Mamma** and **Liberty Bell** claims. Shipment is expected to be at the rate of 500 tons per month by mid-summer.

Climax Molybdenum Company has sold all of its company-owned houses at Climax and Leadville, Colorado to **John W. Galbreath & Company.** Climax formerly rented houses to its employees, but is now out of the rental business. Under the sale agreement company employees have first opportunity to purchase the houses they live in; however, all houses must be moved from the Climax mine. Plans calling for moving most of the 613 houses to Leadville.

Farwest Mining Limited, a Canadian company, has purchased 200,000 shares of **Lake Central Mines** which is developing gold-silver-lead-zinc veins through the **Big 5 Tunnel** at Idaho Springs, Colorado. **Beaver Lodge Uranium Mines Ltd.** of Vancouver, British Columbia holds controlling interest in **Lake Central.** The **Contract Engineering Company** of Denver, as **Lake Central** operator reopened the **Big 5 Tunnel,** sunk a churn drill hole for ventilation, and cage-raised around the hole to gain access to sections of veins not mined through the tunnel.

American Metal Climax Foundation has made an unrestricted grant of $10,000 to the Colorado School of Mines Foundation, Inc. for the continuing faculty improvement program supported by the latter organization. This is the second such grant made by **American Metal Climax Company, Inc.,** which evolved from the merger in recent years of **American Metal Company, Ltd.,** and **Climax Molybdenum Company.**

Colorado School of Mines at Golden has received two gifts that will mean more equipment for its mining and geology department. One was a $2,230 grant made by George W. Morehouse, uranium operator, of Grand Junction, Colorado, that will be used to purchase a $1,730 Franx separator for the geology department and to buy stress and strain gauge meters from the University of Durham, England. Morehouse, a 1949 graduate, received his master of science degree from the school in 1950. The second gift was $40,000,000 worth of mining equipment previously used in U. S. Bureau of Mines exploration work. For use in the school's experimental **Edgar** mine at Idaho Springs, Colorado, it includes eight drifters, 19 jackhammers, and various mountings, dies, and drill steel.

SOUTH DAKOTA

Uranium in the Sharon Springs member of the Pierre shale in South Dakota and northeastern Nebraska is the subject of a report of the **United States Geological Survey.** In an investigation for the **Atomic Energy Commission,** over 300 samples of the Sharon Springs members, a black organic marine shale of Late Cretaceous age, which were taken from 30 exposures and two core holes, show that the uranium content averages about 0.0015 percent throughout the region studied. The most uraniferous parts are about three inches thick and contain as much as 0.025 percent uranium. The thickness ranges from 1 to 42 feet along the Missouri River, and is up to 106 feet thick on the eastern flank of the Black Hills. Rocks equivalent to this member extend into North Dakota and eastern Montana, but radio-activity decreases northward and westward. Illustrations and tables in the report include an outcrop map of the member along the Missouri River, graphic sections, a map showing lines of equal radiactivity, and a diagram showing correlation between uranium and 32 other elements in the member.

The Pittsburg Pacific Company of Hibbing, Minnesota, operated the open-pit iron-manganese mine near Fort Thompson, South Dakota, in hopes of mining 200 to 300 tons of material before the ground froze. The little-known mine was worked overtime to get a usable sample for metallurgical tests to determine if its quality merits a full-scale mining operation.

Present capacity of the uranium processing mill of **Mines Development, Inc.,** at Edgemont, South Dakota, is approximately 400 tons of ore per day. The mill was completed in 1956, and expanded in 1958.

UTAH

Federal Uranium Corporation and **Radorock Resources Inc,** two Utah Mining companies which operate uranium mining and milling facilities together, have completed a merger. The two firms have equal ownership of **Dynamic Metals Corporation** and **Beryllium Resources, Inc.,**

Standard U_3O_8 Purchases Marcy-Shenandoah

Standard Uranium Corporation has exercised its option to purchase the interest and assets which Marcy-Shenandoah Corporation of Durango, Colorado has had in Shenandoah Limited. Standard Uranium, headquartered in Moab, Utah, has held half of Shenandoah Limited's assets since March, 1959, with an option on the remaining 50 percent. Price of the purchase was in excess of $500,000, according to S. Stokes Tomlin, Jr., Marcy-Shenandoah president. The acquisition included the Shenandoah mill at Silverton, Colorado, shown above, where a new sampling plant is under construction for scheduled operation next summer. Standard's main activity in the Silverton district is driving of the American Tunnel from Gladstone to a point under the old workings of the Sunnyside mine where a raise will be driven to dewater these workings. This will make possible a new mining and transportation plan for the several hundred thousands of tons of zinc-lead-gold-silver ore blocked out in the Sunnyside. This ore will be trucked to the Shenandoah mill for treatment.

formed with other companies to enter the beryllium field. Radorock Resources was organized in 1956 by Federal Uranium to receive all Federal's interest in the Radon and Hot Rock claims in the Big Indian mining district of San Juan County, Utah.

United States Smelting Refining and Mining Company, in 1959, continued usual operations at its **U. S.** and **Lark** Mine and at its Midvale, Utah, flotation mill, but stockpiled lead and zinc concentrates produced since mid-August because of strike situations. The basic wage scale in effect at the mine and mill since May 1957 was increased, effective last October 1.

Hamlin Exploration & Mining Company has contracted to assist in final development of the large **Ranrex Oil & Mining Company, Inc's.**, beryllium property in the Sheeprock Mountains of western Utah. Five years of exploration and development has proven more than 3,000,000 tons of low grade beryllium bearing rock and present work should boost proven reserves to more than 5,000,000 tons, according to reports. A two-shift per day drifting program is underway at present to determine the vertical depth in one area to 600 feet. Ore haulage roads have been built and crushing equipment and ore bins installed. The mineralization is non-pegmatite. Beryllium occurs mainly as beryl "bursts" of radiating crystals contained in a leucoquartz monzonite. Minerals have been found capable of mechanical upgrading and amenable to economical flotation processes.

Utex Exploration Company, headed by Charles A. Steen of Moab, Utah, has gained control of **Grand Deposit Mining Company** of Salt Lake City from incumbent directors who proposed another assessment on the firm's stock. Culminating a long attempt to acquire control, the Steen group now has control of some 1,300,000 shares of Grand Deposit stock. Its principal assets are mining claims in White Pine County, Nevada, on which Utex had leased a copper prospect, and some oil and gas leases in northern Grand County.

Columbia Geneva Division of **United States Steel Corporation** has started construction of its new raw materials research laboratory at **Geneva Works** in Utah. A modernization and improvement program is also under way.

A new mining company, **Western Mining Corporation**, has filed incorporation papers and established offices in Riverton, Wyoming. Capital stock is 50,000 shares with no par value assigned. Directors are Donald J. Kelley, Darry Kelley, John Erickson, John Nemi, and Wayne Erickson, with the latter in charge of the Riverton office.

Western Uranium Corporation has opened a new open-pit mine called the **Storm** mine in Crook County, near Hulett, Wyoming. It is located 2½ miles east of the underground mine of **Homestake Mining Company**, largest uranium producer in northeastern Wyoming. According to Wayne Erickson, general manager, uranium in **Western's** mine is found in the upper Fall River formation. The ore body is shallow, averaging about 20 feet of overarburden, and the ore is about seven feet thick.

The **Sunrise** Wyoming iron ore mine of **Colorado Fuel & Iron Corporation** was awarded the Joseph A. Holmes Safety Association certificate of honor for operating 3,930,711 man-hours without a fatality or permanent total disability, with an average of 295 men.

JOT Mining Company of Oklahoma City, Oklahoma, continued its open pit uranium mining operations on Bokan Mountain, south of Ketchikan, Alaska, until weather conditions put an end to mining late in 1959. Early in January the company made a barge shipment from the Ross-Adams property on Bokan Mountain, Prince of Wales Island, to the **Dawn Mining Company's** uranium mill in Ford, Washington, near Spokane. Mining has ceased until spring, but the company definitely plans to resume operations then.

Assays of gold ore opened last fall in a raise at the **Mikado** mine in the Chandalar District of Alaska bear out old reports of high-grade found in the bottom of a 105-foot shaft. The assay report from the Alaska Division of Mines and Minerals said some of the gold is free milling and some is associated with sulfides. **Little Squaw Mining Company**, controlled by **Grandview Mines** and **Metaline Mining and Leasing Company** of Spokane, Washington, plans to resume operations in the spring.

The **United States Geological Survey** has released a report on the geology of the Mount Katmai area of Alaska, published as Bulletin 1058-G, and another describing three possible sources of hydrite raw material, Bulletin 1039-C. Also released are six reconnaissance geologic maps of Norton Bay, Candle, Melozitna, Ruby, Unalakleet, and Nulato quadrangles in western Alaska. The maps are published in the Miscellaneous Geologic Investigations series.

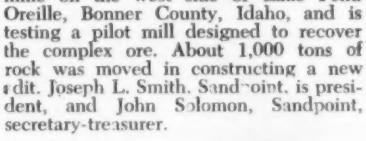
A silver-copper vein discovered recently at a depth of 3,000 feet in the **Galena** mine west of Wallace, Shoshone County, Idaho has been opened for 250 feet in ore. The vein contains a streak of **high-grade up to 18 inches in width.** It was found north of the Polaris Fault, an area formerly not given much attention by Silver Belt operators. **American Smelting and Refining Company** is operating the property under a long-term lease and profit-sharing agreement with **Callahan Mining Company. Day Mines, Inc.**, has a 25 percent working interest.

Construction of the **Bunker Hill Company's** new phosphoric acid plant near Kellogg, Shoshone County, Idaho, is ahead of schedule and first production is anticipated about July 1. The main process building has been enclosed with asbestos sheets over two-inch wood sheeting. Two railroad spur lines have been completed and machinery is being delivered and installed. W. Dean Wilde has been named plant superintendent. He formerly was smelter development metallurgist. The company's net profit for 1959 was $322,458, as compared with a loss of $2,200,000 the previous year. During the year improved markets caused the firm to reactivate the fifth unit of the Kellogg electrolytic zinc plant.

At the **Dayrock** mine north of Wallace, Idaho, continuing exploration of the recently discovered **Hornet** vein by drifting to February 1 has exposed about 120 feet of ore which can be stoped over widths of four and a half to more than seven feet. Muck piles have averaged about 8 percent lead and 8 ounces of silver to the ton. The ore is continuing in both east and west faces, according to Henry L. Day, president of **Day Mines, Inc.**

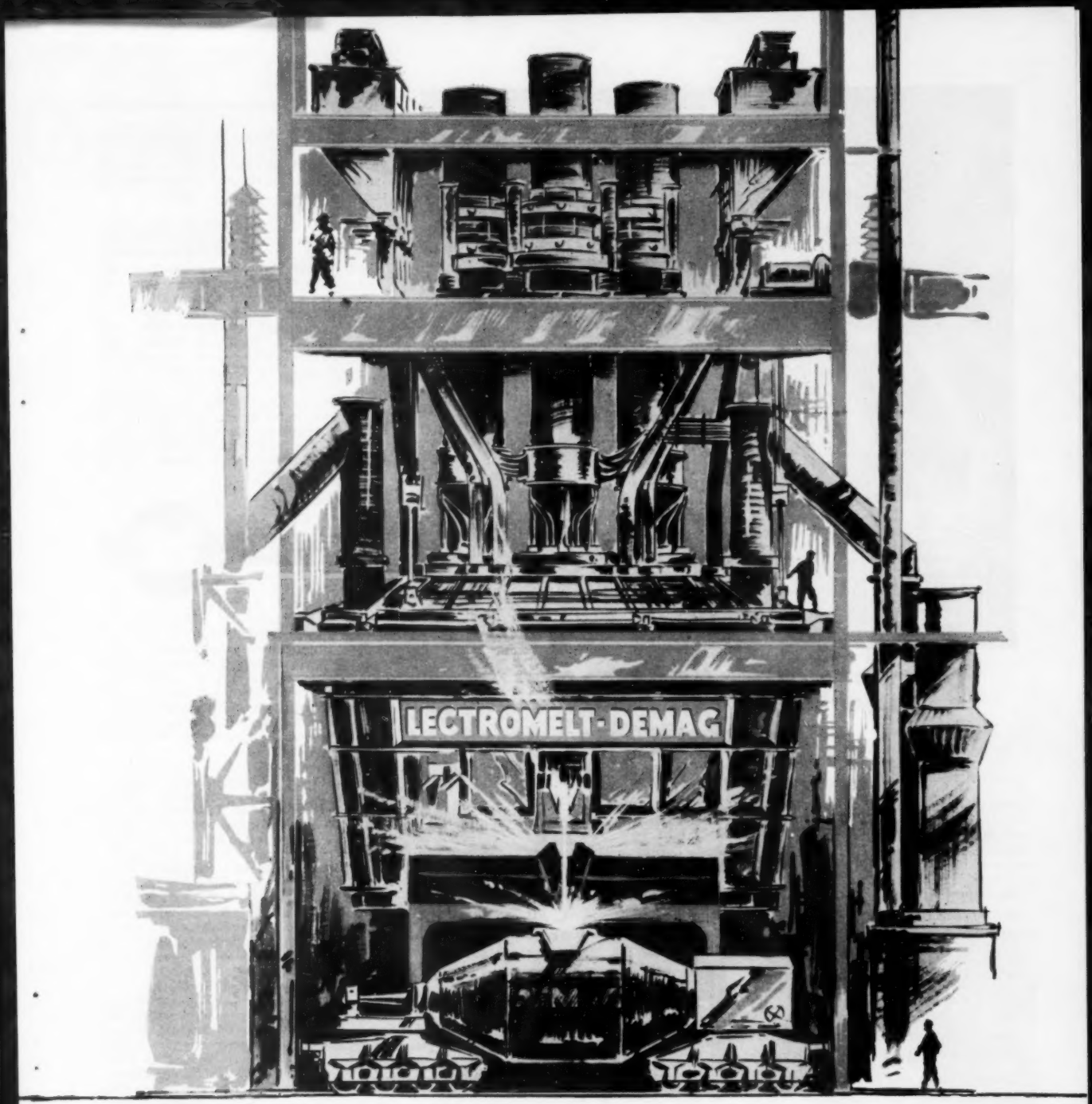
Three Coeur d'Alene mining region companies have filed suit in federal district court in an effort to enjoin the **Securities and Exchange Commission** from enforcing an administrative ruling that levying of assessments on assessable mining stock constitutes an offering and sale of securities within the meaning of the 1933 Securities Act. They are **Callahan Consolidated Mines, Inc., Bismarck Mining Company,** and **Nabob Silver-Lead Company.**

Telache Farm Improvement Association has reopened the old **Telache** silver mine on the west side of Lake Pend Oreille, Bonner County, Idaho, and is testing a pilot mill designed to recover the complex ore. About 1,000 tons of rock was moved in constructing a new adit. Joseph L. Smith, Sandpoint, is president, and John Solomon, Sandpoint, secretary-treasurer.



Winter work at the **Jack Pine** phosphate deposit near Elliston, Powell County, Montana, consisted of the driving of two tunnels in different parts of the phosphate bed to follow diamond drilling and bulldozing done last year. Snow, high winds, and temperatures down to 40° below zero handicapped crews. Al Nugent is exploration geologist in charge for the **Bunker Hill Company,** Kellogg, Idaho, mining, smelting and refining firm, which is building a $2,000,000 phosphoric acid plant adjacent to its electrolytic zinc plant.

Nancy Lee Mines, Inc., of Superior, Montana was scheduled to reach its current objective about March 1. This was an oreshoot indicated by downhole diamond drilling. To reach the area required deepening the shaft 150 feet and crosscutting 300 feet. Wendell Brainard, Kellogg, Idaho, is company president.



New highs in efficiency, economy and safety with LECTROMELT-DEMAG electric smelting furnaces

The advanced design of the Lectromelt-Demag smelting furnaces assures you of the highest electrical and thermal efficiency. For example, electrical losses in the electrodes are minimized by low-level electrode clamps. Hydraulic compression of contact clamps provides uniform pressure, preventing distortion.

Ease of operation gets similar attention. All operations are planned for handling by semi-skilled operators. Furnace controls are mainly mechanical or automatic, with provision for remote control.

To this efficient Demag design, Lectromelt brings its experience in engineering and quality workmanship. The result is unmatched economy and dependability in all smelting applications.

For help in adapting electric furnaces to your requirements, contact Lectromelt Furnace Division, McGraw-Edison Company, 324 32nd Street, Pittsburgh 30, Pa.

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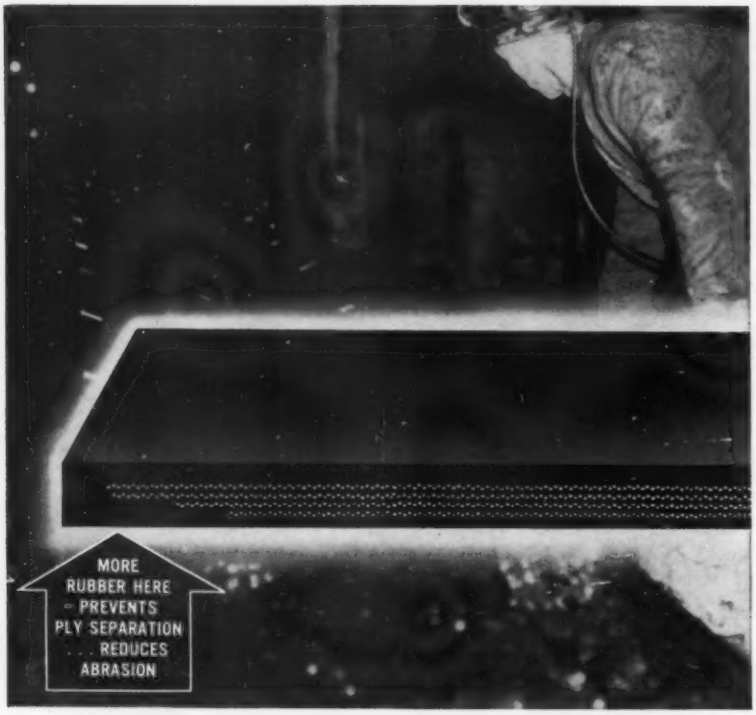

EXCLUSIVE "COLEDGE"* CONSTRUCTION

gives Quaker Thermoid Conveyor Belting extra life where it counts

Unique "Coledge" construction puts more rubber *at the edges* where it's needed, prevents ply separation, makes a more flexible and wear resistant edge where abrasion is greatest. Punishment at the edges—especially the tough use dealt out in mining—can kill most conveyor belting in a fraction of the lifetime of Thermoid-Quaker belting.

Tests show Thermoid-Quaker "Coledge" construction lasts and lasts on the same jobs where other belting fails. "Coledge" construction is available on all grades of Thermoid-Quaker belting.

What's more, all Thermoid-Quaker conveyor belting is prestressed in manufacture, so that the belt is actually in compression when you get it—ready for the heaviest load without strain.

Examine Thermoid-Quaker Belting with the exclusive "Coledge" construction at your Thermoid distributor's, or write for further information to Thermoid Division, H. K. Porter Company, Inc., Tacony & Comly Streets, Philadelphia 24, Pa.

*Patent Applied For

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NORTHWEST

Zonolite Company has added several silo-type bins at its vermiculite mine near Libby, Montana increasing its primary storage capacity. **Haskins Steel Company,** Spokane, Wash., had the contract.

Sale of **Butte Copper & Zinc Company's** properties to **Anaconda Company** for $1,325,000 in cash has been approved by directors. Anaconda has been operating the firm's manganese and zinc properties for a number of years. Stockholders were expected to approve a previous proposal to transfer Butte Copper's assets to **Jonathan Logan, Inc.,** manufacturer of women's dresses, for 600,000 shares of common stock.

Two new mining firms have been incorporated in Montana, the secretary of state announced. They are the **Independent Oil and Mining Company** of Billings and the **West Range Mining Company of Butte.**

OREGON

The **U.S. Bureau of Mines'** Albany, Oregon Metallurgy Research Center is experimenting with depleted uranium to determine if it imparts exceptionally high tensile strength to steel as some metallurgists contend. Depleted uranium is a byproduct of the enriched uranium produced for the **Atomic Energy Commission.** Most of the fissionable U-235 has been removed.

A report on the copper-cobalt deposits of the Quartzburg district in Grant County, Oregon, has been released in open files by the United States Geological Survey. Copies of the 20-page report by John S. Vhay may be consulted at the Department of Geology and Mineral Industries, State Office Building in Portland, Oregon; in Geological Survey offices in Spokane, Washington; San Francisco, California; and Salt Lake City, Utah; and in Geological Survey libraries in Washington, D.C.; Denver, Colorado; and Menlo Park, California.

An all-day session on gold that will include outstanding speakers plus an experts' panel discussion is a highlight of the 1960 Pacific Northwest Metals and Minerals Conference to be held in Portland, Oregon, April 28, 29, and 30. Headquarters for the conference, sponsored by the AIME, are at the new Sheraton hotel. Among speakers at the April 28 sessions will be Norman L. Peterson, geologist with the Oregon state department of geology and mineral industries, who will discuss the geology of the Lakeview, Oregon, uranium area; John McKee of **Fremont Mining Company,** whose subject will be drilling of an Alaskan sulphide deposit under a glacier, and D. Vidensky, who will give a paper on nickel smelting at Riddle, Oregon. At the Friday, April 29 program covering gold, Dr. Donald H. McLaughlin, president of **Homestake Mining Company,** San Francisco, California, will be the first speaker, reviewing the gold problem by world and countries, and covering the relationship to gold production and reserves. He will also appear with five others in the panel discussion moderated by Evan Just of Stanford University, California. Other

speakers Friday are Philip Cortney, president of **Coty, Inc.**, and E. F. Baroch of **Wah Chang Corporation**, Albany, Oregon.

WASHINGTON

A mining area near Pateros, Washington that has long been inactive is now the location of operations by **Paymaster Mines, Inc.**, which made its first shipment of ore to the Tacoma smelter in January. Operated by a small group of men, the area includes 30 claims along Squaw Creek, 16 miles northwest of Pateros and four miles off the Methow Valley highway. A 50-ton Cully mill has been set up to separate gold, silver, copper, and tungsten by specific gravity rather than flotation. Paymaster Mines is presently concentrating development on seven veins, with ore being taken first out of the Hunter vein. Work at the mines, begun in April 1960, includes opening up old tunnels on the property, setting up the dam and sawmill, and building the mill. Paul Rogstad, is president and manager of Paymaster Mines.

Kaiser Aluminum & Chemical Corporation will step up its primary aluminum production during 1960 to about 609,500 tons. Plans indicate the increase will be accomplished by re-starting two 22,000-ton potlines at its Mead works in Spokane. Another 27,000-ton line in Louisiana may also be started early this year.

Northwest Magnesite Company, largest domestic producer of dead-burned magnesite, again is operating at near capacity with 200 men on the payroll. Operations at the firm's kilns at Chewelah, Stevens County, Washington were shut down last summer by the steel strike, but resumed in October. Howard R. Ziebell is plant manager.

The **Gold Bug** mine near Danville, Ferry County, Washington, last operated in the 1900's, has been acquired by Forrest Renslow, Spokane, who also has mining interests in the Orient and Metaline districts of northeastern Washington. He plans to start mining and shipping of copper-gold-silver ore this spring, and to undertake extensive development and exploration work.

Installation of a molybdenum mill is the goal of **Pitney Butte Mining and Smelting Company, Inc.**, recently organized to take over assets of the old **Spokane Molybdenum Mines, Inc.** in Lincoln County, Washington's Egypt mining district. Henry A. Trinke of Moses Lake is president of the new Delaware Corporation.

Trenching, sampling, and metallurgical testing were carried out this past field season at the old **South Penn** open-pit gold mine in the Republic district of Ferry County, Washington. The work, done by **Thomas Consolidated Mines, Inc.** of Spokane, extended the known mineralized zone up to 75 feet beyond the pit boundaries, and indicated a total width of nearly 300 feet. Glacial overburden is 10 to 18 feet thick. Tests showed the ore is amenable to cyaniding. David E. Watson, Spokane, is president and manager.

SAUERMAN NEWS briefs

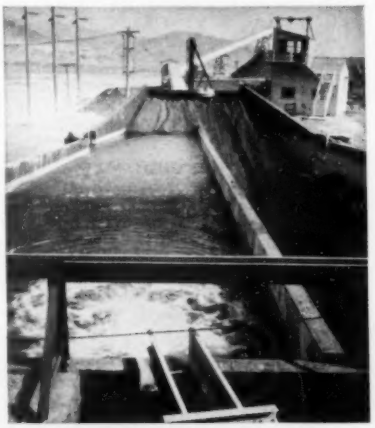
SAUERMAN BROS., INC.,
638 South 28th Avenue, Bellwood, Illinois
Linden 4-4892

Cableway-DragScraper Blends, Reclaims Stockpiled Ore

Over a million tons of iron ore may be stockpiled in the new facilities of a South American mining company. The DragScraper permits better blending of the ore and reclaims all stockpiled material that does not flow by gravity into two 3000-ltph. tunnel conveyors.

The 10-yd. Dragscraper is suspended from a carriage traveling on a track cable between two self-supporting towers. These travel on tracks paralleling the storage area. Despite the size of the Sauerman installation, it may be controlled by one man.

(Condensed from a forthcoming Sauerman News)



Efficient Slag Removal

A 4-yd. Sauerman DragScraper machine is incorporated in the waste slag disposal system of a large copper smelting operation. The slag is flumed into two dewatering tanks separated by a common wall. After a tank is drained, the slag is reclaimed by the DragScraper to a hopper at the head end. The DragScraper is remotely operated from a station above the hoist to provide good visual coverage of the installation.

The monorail-trolley assembly at the tail end provides lateral movement of the DragScraper. The monorail spans the tanks, and a Durolite single block on the trolley carries the backhaul cable. Shifting is handled by a motorized winch remotely controlled by the hoist operator.

The DragScraper reclaims to the hopper at about 250 tph. The hopper, in turn, feeds a conveyor belt which carries slag to the disposal area.

(Condensed from Sauerman News No. 155)

Handling Phosphate Ore

Ore concentrate is stockpiled and reclaimed as required to the foot of a bucket elevator by a Sauerman DragScraper Machine at a Southern chemical plant.

A self-propelled tail tower travels around the perimeter of the stockpile. The tower is shifted to change the line of operation. DragScraper haul length is 400 ft. The operator's station for the Sauerman hoist is located above the conveyors to give a clear view of the pile.

(Condensed from Sauerman News No. 151)

MORE NEWS AND INFORMATION

Issues of Sauerman News giving greater detail about the installations on this page are available on request. For more information on your materials handling requirements, contact Sauerman Bros., Inc., 638 S. 28th Ave., Bellwood, Ill. Linden 4-4892.

precipitates—CENTRAL AND EASTERN

CENTRAL STATES

The Chase-Park Plaza Hotels in St. Louis, Missouri, will be headquarters in early April for annual meetings of both the **Lead Industries Association** and the **American Zinc Institute**, with one day of each meeting scheduled for a joint session. The Lead Industries group meets April 6 and 7. At the joint session with the Zinc Institute April 7, the program will cover developments in foreign trade and reactions of foreign producers to the development of world lead and zinc markets. The Zinc Institute, which has its meeting April 7 and 8, will discuss mining economics.

The best safety record in its history was established during 1959 by **United States Gypsum Company**, headquartered in Chicago. Lost-time frequency rating was 1.8, as measured by American Standards Association. Perfect records were achieved by 34 out of 59 plants. Personnel worked 25,000,000 man-hours during the year, with no fatalities, and fewer accidents than in previous years. The 1959 record was a 30 percent improvement over 1958 when the company set an all-time safety record for one month—May, with 1,750,000 man-hours without a lost-time injury.

At the **Pea Ridge** iron project of **Meramec Mining Company**, a drift is being driven from the shaft on the 1,699-foot level of the No. 1 shaft, which will be used for men and materials when the mine is in operation. The nearby No. 2 shaft is to be used for hoisting ore.

Freeport Sulphur Company is testing a new type of aluminum piping at its **Chacahoula** mine near Thibodaux, west of New Orleans, Louisiana. The 3½-inch pipe, with a 3/16-inch wall, has a built-in section through which steam travels to keep sulphur molten. Designed for easy bending, the pipe requires no special connections at expansion loops, is lighter, needs less support, and is easily installed. Aluminum rods are used in welding, which requires inert gas such as argon to shield the weld. Special precautions will be used during the test to prevent steel corrosion, which was a problem when a similar test was made at Freeport's **Grand Ecaille**, Louisiana mine some time ago.

Continuation of drilling operations prospecting for iron ore in Southeast Missouri during this year is planned by **American Zinc, Lead and Smelting Company**, St. Louis, Missouri. This program, which shows encouraging results, is a joint arrangement with the **Granite City Steel Company**.

The General Services Administration has announced the coming sale of 165,273 pounds of packaged zinc-oxide pellets, now located at Granite City, Illinois. Pellets will be offered "as is-where is" in one lot, and sealed bids will be received until March 18. Those interested may contact James V. O'Dwyer, Room 6030, General Services Administration, 18th and F Streets, NW, Washington, D. C. The agency may decline all bids, if not satisfactory.

A program of scholarship and fellowship awards in the field of agriculture and mining has been established by **International Minerals & Chemical Corporation** of Skokie, Illinois. Named for the IMC board chairman, Louis Ware, the program provides for 12 $1,000 senior year scholarships to students who wish to pursue graduate studies in mining and agriculture. The six students in each area will then compete during their senior year for a $3,000 annual fellowship leading to a doctorate degree. The project was announced at a dinner honoring Mr. Ware on his 20th anniversary with the company.

Mining map files that represent 10 years of compiling and microfilming data for the lead and zinc resources in the Tri-State mining district are now available in Joplin, Missouri. The material includes microfilms of 95,700 churn drill hole logs and maps of 2,036 properties covering 760,000 acres in the Tri-State district, according to Harold M. Smith, regional director of the **U. S. Bureau of Mines**, Bartlesville, Okla. Because much information in the files was given in confidence and is not for general publication, they can be seen by appointment only. Files are located in room 204 of the Joplin post office, Third Street and Joplin Avenue. Appointment requests should be made to the **Tri-State Zinc-Lead Ore Producers Association**, or to one of two custodians: J. L. Woolsey, Box 338, Rte. 1, Joplin; or R. K. Stroup, Box 308, Baxter Springs, Kansas.

EASTERN STATES

A break in the impounding dam at the **Noralyn** mines of **International Minerals and Chemical Corporation**, Bartow, Florida, recently damaged warehouse and machine shop sections, so that plant operations were suspended for about 24 hours. When the dam gave way, a substantial amount of slime was released into the plant and also flowed into Six Mile Creek nearby and entered Peace River, causing considerable turbidity for three days. A sandbag dam was quickly constructed to halt much of the slime material before it reached the river. Cause of the dam break was thought to be the bubbling of an underground spring, which saturated the earthwork footing until the wall collapsed. IMCC dams are built to withstand twice the pressure that is expected to develop and the section that failed was inspected just an hour before the breakdown. A similar break occurred recently at the Swift phosphate dam.

Copper production in Tennessee in 1959 increased 24 percent over 1958, setting a new record of 7.0 percent above the previous record established in 1931. **Tennessee Copper Company** at Copperhill, Tennessee is the largest producer. Low grade copper occurs in massive sulphide deposits that yield principally pyrite and pyrrhotite.

Cranberry Magnetite Mine Produces Again

In production once more after nearly a quarter-century of idleness is the Cranberry iron mine in Avery County, North Carolina, which produced over 1,500,000 tons of magnetite between 1881 and 1931. Now operated by the Cranberry Magnetite Corporation, the mill shown above produces 300 tons of concentrate daily. The coarse magnetite, plus ¾ inch, minus ¾ inch, is shipped to a blast furnace. The wet concentrate, plus-10-mesh, minus ¾ inch, is sold for heavy density concrete aggregate, and the minus-10-mesh concentrate is sold for medium in ore and coal separation plants. An old 500-foot tunnel has been reopened to make ore in the mile-long tunnel level available, and water is being pumped out of the lower level (60 feet lower) which parallels the tunnel level for a half mile. Mine run ore averages 40 percent iron and is being concentrated to 58 percent iron. Over 7,000,000 tons of ore are blocked out in the present mine area, and a core drilling program is starting soon to check a magnetometer anomaly. The flow sheet of the mill resembles that suggested by the U. S. Bureau of Mines in the 1940's.

CENTRAL AND EASTERN

The **Ninth National Clay Conference** will be held at Purdue University, Lafayette, Indiana on October 6, 7, and 8, 1960. It will be held under the auspices of the **National Academy of Sciences-National Research Council.** Two symposia of invited paper will be held on "Engineering Aspects of Physico-Chemical Properties of Clay" and "Clay-Organic Complexes." Those wishing to present papers are asked to contact Dr. J. L. White, chairman of the conference, at the Agronomy Department of the University. Title and abstract of about 250 words should be submitted by June 1.

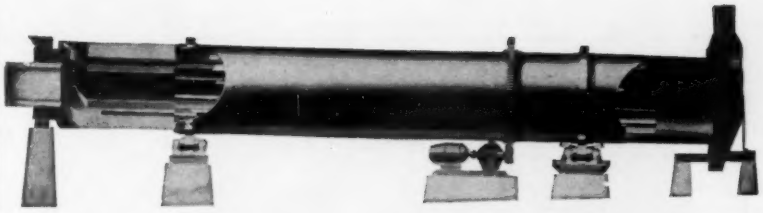
Crucible Steel Company of America has purchased a Dortmund Horder Huttenunion degassing unit for its Midland, Pennsylvania plant, and it is to be operating on a pilot production basis later this year. The equipment will be used to improve special purpose steels, and will be the first such installation in the United States. It will be capable of degassing alloy steel heats up to 200 tons at a rate of almost 1,000,000 tons per year.

A wet scrubber that will almost completely remove "dust" ejected into the air by phosphate rock drying plants has been installed at the Ridgewood, Florida, plant of **Davison Chemical Division** of **W. R. Grace and Company.** The system, designed by **Wellman-Lord Engineering, Inc.,** of Lakeland, Florida, is the first installation of this type in the field. The wet scrubber is a secondary dust remover used in conjunction with the primary cyclone dust remover, which eliminates almost all dust from the atmosphere. The new scrubber uses 15 gallons of water per minute and handles 145,000 cubic feet of exhaust gas per minute. The scrubber includes high pressure water sprays, a water-filled tray, and a baffle-type water eliminator which unloads the bulk of the water accumulated during the process.

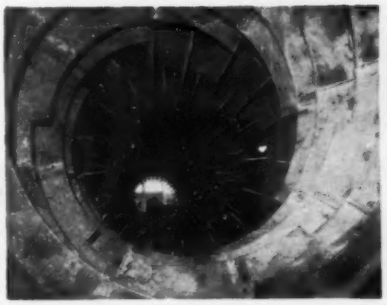
Development of a newly discovered wollastonite deposit at Lewis, New York, will be one of the first projects undertaken by the **Adirondack Development Corporation** formed recently by a group of New York businessmen with headquarters in Keesville, New York. Kallastonite [(Ca, Fe Mn) SiO_3] has potential use in the ceramic, paint, and plastic industries. Garnet is a byproduct of wollastonite mining in Essex County and various grades have been marketed as abrasives.

IRON RANGES

A recent tabulation of domestic iron-ore resources by the United States Geological Survey estimates the total as approximately 75,000,000,000 long tons of crude ore. The amount includes about 10,000,000,000 tons as reserves, material usable under existing economic and technical conditions, and 65,000,000,000 tons of ore potentially available under more favorable conditions. The potential ore may yield 25,000,000,000 tons of concentrates and direct-shipping ore. Inclusion of additional low-grade material, the magnetic taconite of the eastern Mesabi Range in Minnesota, is mainly responsible for the increase of 25,000,000,000 tons to estimates made several years ago. Greater cost of beneficiating taconite com-



from **A**lumina ores to **Z**ircon concentrates



Interior of shell of "XH" Ruggles-Coles Dryer showing lifting flights and feed spirals.

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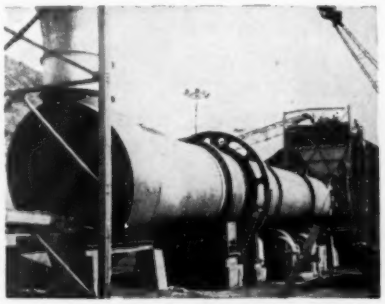
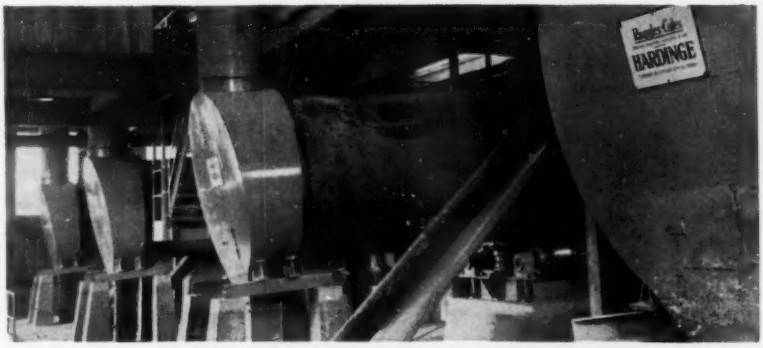


10′ diameter, 80′ long "XH" Ruggles-Coles Dryer drying bauxite in Jamaica.



Four 80" diameter, 60′ long "XH" Ruggles-Coles Dryers handling asbestos ore in Canada.

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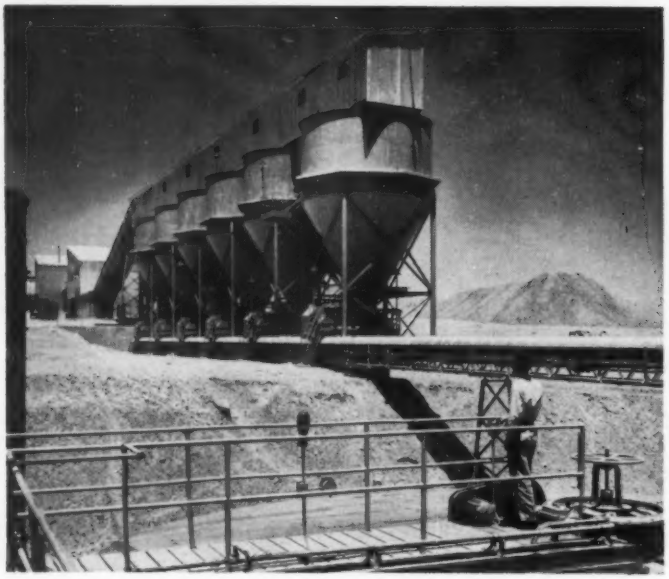
pared to direct-shipping ore is offset by savings in shipping charges and blast furnace operation. Present annual needs of steel manufacturers in the United States are 110,000,000 long tons of iron ore and 70,000,000 tons of scrap iron and steel—twice the average annual consumption of iron ore between 1900 and 1930. Further data is contained in the Geological Survey Bulletin 1028-C available at 75 cents from the Superintendent of Documents, Washington 25, D. C.

Daily shipments of 1,000 tons of taconite from the Mesabi Range are being received by **United States Steel Corporation** for its Gary, Indiana, works where it is charged directly to open hearths. **Inland Steel Company** at Chicago, which does not usually get ore by barge during the winter, expects to ship in about 200,000 tons of Chilean and Peruvian ore by barge from New Orleans where it is unloaded from ocean going ships. The Peruvian ore, which runs about 50 percent iron, is in the form of concentrated fines for sintering, while that from Chile is lump ore for use in open hearths. The Chilean ore runs about 60 percent iron.

The **Pioneer** mine of **Oliver Iron Mining Division** located at Ely, Minnesota was recently awarded the Sentinels of Safety Trophy for 1958. This mine showed the best safety record for underground metal mines when 450 employees worked 713,118 man-hours without a lost time accident. The mine recently received a replica of the Bronze Trophy for permanent possession and is privileged to fly a green and white Sentinels of Safety flag over the mine.

Technical innovations in both mining and the steel industry have been delaying further development of a taconite plant in southern Ashland County, Wisconsin, according to the **Ashland Mining Corporation.** The innovations relate to such things as blast furnace operations, the use of oxygen converters, and the processing of iron ore. The firm is studying recent developments closely "to determine the best and proper use which should be made of such a mining property as the one in the Butternut area." Others who have drilled extensively in this area in the last few years include **Jones & Laughlin Steel Corporation** and **Snyder Mining Company.** In 1959, **Cerro de Pasco Corporation** explored in Bayfield County and reportedly acquired options in Douglas County. The firm is drilling to extreme depths for native copper and chalcocite believed to be an extension of the **White Pine** copper formation in Ontonagon County, Michigan. **Bear Creek Mining Company, Kennecott** subsidiary, has drilled Iron and Bayfield counties, Wisconsin in the past two years.

Reserve Mining Company shipped 3,640,008 gross tons of iron pellets during the 1959 lake shipping season, in spite of interrupted production and shipments during the steel strike. From November 7 through December 13, when navigation ceased, 850,244 tons of pellets were shipped from Silver Bay. Estimated stockpile of pellets on November 7 was 600,000 tons, and on December 13, 216,000 tons, with 240,000 tons added by December 31. Stockpile estimate for January 1 was 456,000 tons. Reserve's rate of annual pellet production is over 5,500,000 tons.



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Ore blending is particularly important in some uranium concentration. Multiple storage and conveying designed and built by Stearns-Roger has met the requirements of this southwestern producer. For materials handling, as for other important operations in the processing of metallic or non-metallic ores, rely on the complete services of Stearns-Roger for design, engineering, fabrication or field erection.

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ARIZONA

The **Mohave Mining and Milling Company** of Wickenburg, Arizona has announced its decision to liquidate the company with December 1, 1960 as the date set for completion of the task. At present, Mohave is operating its sintering plant, north of Wickenburg, to fulfill contracts and purchase orders. The plant, with four employes, is processing about 2,000 tons of manganese per month from inventory already on hand. The sintered product is shipped to **Kaiser Steel Company** in Fontana, California. The sinter plant probably will run for another month or so and the entire operation will be cleaned up early in the spring. Mohave's manganese mill was closed down last August, but the assay office located at the site of the Box Canyon mill will remain open temporarily and be available for custom work. Liquidation details will be handled from the firm's offices on the California Highway west of Wickenburg. H. F. Lynn is president of the company and Rod Easley, executive vice president and general manager.

Investigation of underground uranium mines of the Southwest revealed that of 16 mines sampled on Navajo Reservations in Arizona and New Mexico, half had maximum radon gas concentration of more than five times the working level (300 micromicrosuries of radon and its product gases per liter of air). However, of the eight mines with a radiation problem, all but one had either closed the mines or had changed their ventilation system radically. The report of the U. S. Bureau of Mines also said that in many cases the amount of air required to control radon products concentration is no greater than would be common in regular metal mining practice. Mines surveyed include those of **Cameron Mining Company**, Cameron, Arizona; **Shiprock Industries, Inc.**, Samostee, New Mexico; **Industrial Uranium Company**, Kayenta, Arizona; W. B. Hall, Cove, Arizona, and **Gibraltar Minerals Company**, Kayenta Arizona.

Magma Copper Company is reported to have made preliminary plans for an addition to the hospital serving its subsidiary, **San Manuel Copper Corporation** at San Manuel, Arizona. The new wing, designed primarily for out-patient work, will add 9,000 square feet to the present structure and will cost an estimated $100,000. The original hospital building was erected in 1955.

CALIFORNIA

Production of high-purity tungsten from scheelite has begun at Pine Creek near Bishop, California, following completion of an addition to the **Union Carbide Nuclear Company** mill. An extension of the refining stage previously in operation at the Pine Creek mill, the new unit employs the direct method for preparing ammonium paratungstate of this high purity from scheelite and powellite concentrates. Additional personnel have been added at Pine Creek and employment may be increased in the future, according to H. L. McKinley general manager. The new unit may operate round the clock, seven days a week. Air-conditioning and other precautions are taken at the plant to insure purity of the product.

Three studies will initiate the research program in which the **California State Division of Mines** and the **U. S. Bureau of Mines** are collaborating, with the Bureau providing facilities, equipment, materials, and personnel. Cost of the work is being borne by both agencies. The first studies deal with production of tungsten and molybdenum metal by direct electrolysis of scheelite concentrate; development of useful co-products from the anorthosite rock of the San Gabriel Mountains, and slope stability research in open pits. Major portion of the funds will be used on the tungsten-molybdenum project, which has been under development at the Bureau's laboratory in Reno, Nevada. The method is known as fused-salt-bath electrolysis, which mixes scheelite concentrate with alkali phosphates or borates and subjects the bath to electrolysis. Owners of California tungsten deposits, in which scheelite is the major ore mineral, find this project particularly interesting.

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NEVADA

The Hamilton Corporation with headquarters at Ely, Nevada, is developing its **Onetha** mines at the old camp of Hamilton in White Pine County, Nevada with the aid of an OME loan. Lead-silver ore is being mined through the Onetha adit. Morris Engle of the firm of Engle and Engle, Las Vegas, Nevada is company president.

The Belmont Lead Company has been shipping lead-silver ore to a smelter in Utah from the Old Belmont lead mine near the old mining camp of Hamilton, Nevada. M. A. Kite, of Ely is in charge.

Columbia Geneva Mining Company (United States Steel Corporation) is diamond drilling for iron ore in Churchill County south of Lovelock, Nevada. Drilling is to test magnetic anomalies in the Buena Vista iron district. Columbia-Geneva is seeking iron reserves for its steel plant at Provo, Utah. Drilling is being done on three groups of claims owned by the **Nevada Iron Ore Company, Inc.** However, the original lease was held by **Mineral Materials Company** which in turn assigned its lease, with Nevada Iron approval, to Columbia Geneva and **Southern Pacific Company**.

At the **Minnesota** iron ore mine of the **Standard Slag Company** near Yerington in Lyon County, Nevada, the open pit has been deepened 50 additional feet and is now 257 feet below the original surface. The concentrating plant production in 1959 was at the rate of 150 tons per hour on a one-shift-per-day basis. At the company's Gabbs magnesite plant in Nye County, a special mix plant was installed last year.

Dodge Construction, Inc., shipped 145,000 long tons of iron ore from its mines in the Buena Vista hills, Pershing County, Nevada, during 1959. Most went to Japanese steel mills, with 10,000 tons to **United States Steel Corporation** in Geneva, Utah.

Exploration in the Pioche district of Lincoln County, Nevada, by **Bristol Silver Mines Company** continues, although drilling and drifting on the 1200 level last year failed to develop ore there. A 1959 geological study was made from all levels, 500 to 1700, and mapping and resurveying is now being done on all levels. Additional diamond drilling was done below the 1700-foot level to try to locate the ore-bearing limestone beds of the Pioche area, and future plans call for more deep diamond drilling.

Developments by **Getchell Mines, Inc.**, in Humboldt County, Nevada, last year consisted of exploring and blocking out gold oxide ores in the large Getchell vein. Recently the company sunk its three-compartment North Shaft to the 800-foot level to explore and develop the gold sulphide ore zone at that horizon.

At the Manhattan, Nevada, mine of **White Caps Gold Mining Company** of Reno, water has been pumped continuously since June 18, 1959. Equipment installed since then includes an electric

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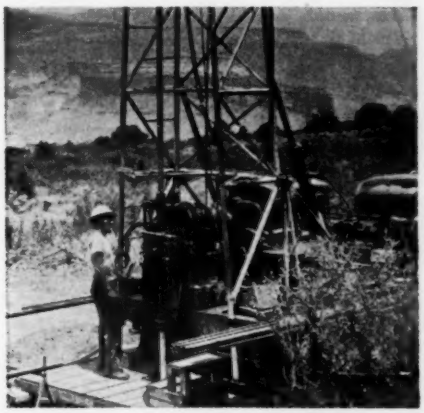

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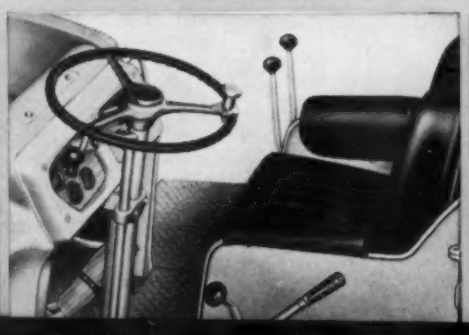

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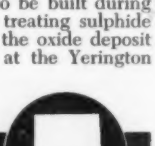
hoist, a headframe, a bin above the winze on the 800-foot level and two sinking pumps. The winze was completely rehabilitated and pumped out down 485 feet on a 45° angle below the 800-foot level, which maps indicate is about 35 feet above the 1,200-foot level. Because of mud and debris, a Flyght pump was purchased so that pumping can be done below the 1,200-foot level. At that level the company will drill to intersect the ore body on the 1,300-foot level. On the 1,100-foot level the company has reached a point in the easterly drift where it is completely blocked, with ore coming down a chute from the stope above. When the pumps clear the 1,200-foot level, the continuation of this ore body will be mined to connect with the ore body on the 1,100-foot level and above.

Normal shipments of iron ore are now being made from Lovelock, Nevada, following resumption of steel mill operations. Ore is being shipped by **Nevada Iron Ore Company**, owned by H. S. Thomas; **Rowe and Austin** of Jungo, Nevada, and **Segerstrom and Heizer.** Some highgrade ore is going to **Kaiser Steel Company** at Fontana, California. Southern Pacific carload shipments totalled 410 during November, with a large portion going to Stockton, California, for shipment to Japan.

Trans-Union Oil & Mining Company has acquired **Goldfield Rand Mines Company** of Nevada through an exchange of stock. Goldfield Rand has gold properties in Nye and Lander counties, Nevada, and a 17.5 percent interest in the **Laurel Bloomery** manganese mines in Tennessee, as well as some oil leases.

Construction on a 1,500,000-gallon reservoir tank has begun at Weed Heights, Nevada by the **Anaconda Company.** The tank is for water storage for the new sulphide flotation mill to be built during the next two years for treating sulphide ore which lies beneath the oxide deposit presently being mined at the Yerington mine.

NEW MEXICO



International Minerals & Chemical Corporation will enter the phosphate field, making the development and use of western phosphate reserves a major corporate objective. The company, one of the most important in the potash industry, already has done considerable work in locating phosphate deposits for development. Selected to head the expansion project, which will include construction and operation of refining facilities, were Carl A. Arend, Jr., former manager of planning for potash operations, and Merton I. Signer, formerly potash plant manager at Esterhazy, Canada. Both men have previously been with the company's Carlsbad, New Mexico, operations.

Stella Dysart and W. Rodney DeVilliers are reported to have purchased the **See Tee Mining Corporation** which is operating the **Mesa Top** and other uranium mines in New Mexico's Ambrosia Lake district. DeVilliers is president of **Rio De Oro Uranium Mines, Inc.,** operator of the largest underground mine in Ambrosia Lake on land which Dysart controlled when uranium was first discovered in what is now the nation's largest uranium district.

Increased efficiency and production have been achieved at the Carlsbad, New Mexico mine and refinery of **United States Borax and Chemical Corporation** with new equipment and modification of existing facilities. A new major screen project for the mine granular plant, completed in December, takes the available crushed ore that meets sizing specifications and separates the potassium salts from the sodium salts by tabling and flotation to produce granular muriate of potash (59 to 61 percent K_2O). As part of the 7,700-foot conveyor belt installation, 2,750 feet of 30-inch belt were installed in the "B" ore body north of the main shaft to permit mining of ore without extending the underground railroad. In the Northeast area of the main ore body, plans include 2,000 feet of 30-inch belting, while in the "A" orebody a 3,000-foot belt installation is planned at the mine's No. 3 shaft to advance the "A" ore body to its outer limits so that first and final mining operations can start, and ore can be hauled more efficiently. Other major phases of the improvement program include a Bird-Humboldt centrifuge at the granular plant; replacement of surface, gas, water, and air lines; a new spare engine for the underground Diesel electric locomotive; mechanization of the Jeffrey tripper that controls distribution of potash, and installation of a Hewitt-Robins car shaker.

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International Ore Dressing Congress Meets In London

The most recent advances in mineral processing throughout the world will be the theme for discussion when the Institute of Mining and Metallurgy meets in London April 6 through 9. Fifth such international gathering, the four-day meeting will provide engineers and scientists in the mining world with an opportunity to meet, exchange views, and hear papers of outstanding technical interest.

The series began in London in 1952, with subsequent sessions held in 1953 in France; in 1955, Germany; and in 1957, Sweden. Headquarters for this year's meeting are at Church House, Westminster, London, S. W. 1.

The technical papers and discussion will cover aspects of fundamental and applied research and development in the fields of mineral dressing and chemical processing, excluding smelting.

All proceedings of the congress will be simultaneously translated into four languages—English, French, German, and Russian. Preprints and the final volume of proceedings will be published in English with synopses in all four languages. Papers by French authors will also be preprinted in French.

A highlight of the session will be the fifth Sir Julius Wernher Memorial Lecture, to be delivered by Dr. I. W. Wark on the opening day, April 6, at 5:00 p.m. Dr. Wark, who will speak on the exploitation of minerals for mankind, is Chief of the Division of Industrial Chemistry, Commonwealth Scientific and Industrial Research Organization, Melbourne, Australia. His lecture in the Assembly Hall at Church House will be open to the public.

Registration in Bishop Partridge Hall of Church House begins on April 6. A reception will follow the Memorial lecture that evening..

Official opening of the Congress April 7 will be followed by technical sessions on comminution and classification in the morning, and on flotation research and flotation practice in the afternoon. Morning sessions on Friday will cover gravity and dense media separation, and magnetic and electrical separation sorting. That afternoon will be devoted to papers on chemical processing and process study. On the final day, Saturday, the group will discuss control and testing, preceding a review session that concludes the scheduled technical program. A dinner dance at Grosvenor House will be given that evening.

Over 70 speakers, representing 19 countries, are preparing papers for the Congress.

From the United States will be Fred D. Devaney, whose subject is "New Developments in the Magnetic Concentration of Iron Ores"; and A. M. Gaudin and Maurice Fuerstenau, whose paper is on "The Mechanism of Thickening."

English representatives, and their subjects include D. G. Armstrong, "Open and Closed Circuit Grinding on a Laboratory Scale"; D. Bradley, "Design and Performance of Cyclone Thickeners"; J. N. Wilson, "Felspar-mica Separation: An Unusual Flotation Flowsheet"; E. Cohen and R. J. Isherwood, "Principles of Dense Media Separation in Hydrocyclones"; G. D. Lill, "Study of the Motion of Particles in a Jig Bed" (in cooperation with the late H. G. Smith); G. H. Jones, "Wet Magnetic Separation of Feebly Magnetic Materials, and Results of Canadian Tests with Magnetic Separator"; A. R. Burkin, "Pressure Leaching of Some Minerals in Alkali Solutions"; F. B. Michell, "Application of Flotation in the Clean-Up of Gravity Tin Concentrates"; L. D. Muller, "Some Laboratory Techniques Developed for Ore Dressing Mineralogy"; and M. J. Cahalan and R. Wolski, "Automatic Control in Mineral Processing."

From Sweden there will be Bengt Fagerberg and Herbert Ornstein, whose paper is "Grinding Tests on Magnetite Ores with Aerofall Mill and with Wet and Dry Rod Mills"; P. G. Kihlstedt and B. Skold, "Concentration of Magnetite Ores with Dry Magnetic Separators of Mortsell-Sala Type"; and Sven Eketorp, "Magnetizing Reduction in a Recuperative Rotary Furnace."

First technical paper at the Congress will be given by R. T. Hukki of Finland discussing "Fundamental Study of Grinding Characteristics of Tumbling Mills." Others from that country will be Urmas Runolinna, Risto Rinne and Sakari Kurronen, collaborating on the subject, "Agglomeration Flotation of Ilmenite Ore at Otanmaki."

Canadian experts scheduled on the program are D. Weston, covering "Theoretical Concepts of the Aerofall Mill with Illustrations of Plant Practice," and J. Leja and G. W. Poling, who will deal with two phases of "Misinterpretation of Contact Angle."

Maurice Rey and Victor Formanek of France will discuss "Some Factors Affecting Selectivity in the Differential Flotation of Lead-Zinc Ores Particularly in the Presence of Oxidized Lead Minerals." Other French authorities and their subjects are J. De Robert and L. Casnabet, "The Forrer Separator: A New Apparatus for Wet Separation of Weakly Paramagnetic Materials"; Robert Bodu, "Recent Development in the Chemical Treatment of Uranium Ore in France," and P. Raffinot, "Statistical Analysis of Some Variables in Flotation Testing, Leading to the Design of a Modified Flotation Cell."

Olav Mellgren, Odd Eidsmo and Marcus Digre will represent Norway at the Congress. The first two will give a paper on "Some Factors Which Influence Ilmenite Flotation," while Mr. Digre will deal with "Separation Factor Analysis for Mineral Dressing Processes."

Two Australians, K. S. Blaskett and W. H. Andrews, will deal, respectively, with "Some Effects of Depressants in the Flotation of a Lead Ore" and "Linear Assessment of Flotation Results." Staff members of the research and development branch of the South Australian Department of Mines will cover "Technical Aspects of Uranium Ore Treatment in Australia."

"Improvement of Classification Efficiency in Hydraulic Cyclones by Water Injection" is the paper prepared by D. F. Kelsall, now in Australia, and J. A.

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Holmes of Northern Rhodesia. A. C. Nesbitt and R. G. Weavind of the Union of South Africa will present "Study of Efficiency of Dense Media Separators Used in Diamond Dressing," and A. A. Linari-Linholm, also of that country, will speak on "An Optical Method of Separating Diamonds from Opaque Gravels." M. G. Fleming of the Royal School of Mines and A. J. Robinson of Uganda will give a paper on "Development of a Process for the Concentration of Sukulu Apatite."

Representatives of other countries and their subjects include: Italy, Gianfranco Ferrara, "A Process of Centrifugal Separation Using a Rotating Tube"; Japan, Masayoshi Wada, "Wetting of Solid in Solutions of Surface-Active Substances as a Function of Solute Concentration"; Federation of Malaya, I. R. M. Chaston, "Developments in the Treatment of Malayan Tin Ores"; Israel, A. Baniel and A. Mitzmager, "Use and Recovery of Tetrabromoethane (TBE) in Mineral Dressing"; Saxony, East Germany, H. Kirchberg and W. Berger, "Study of Some Factors Affecting Concentration on Oscillating Tables"; Belgium, P. Moiset and R. Dartois, "Magnetic Regulation of Underflow Discharge of a Dense Media Washing Cone," and India, G. V. Subramanya and P. I. A. Narayanan, "Beneficiation of Low-Grade Manganese Ores, with Particular Reference to Semi-Pilot-Plant Studies on a Low-Temperature Magnetizing Reduction Process for Ferruginous Manganese Ores."

The U.S.S.R. will send 17 experts, whose greatest field of interest is flotation research and practice. They will present papers on various phases of this subject.

During the week following the Congress, a series of tours has been arranged so that members can visit areas of the United Kingdom of particular industrial interest. The five offered include North England and Scotland, South Wales and West Country, Cornwall, Midlands, and the London area.

South African Break Shaft Barrier – Sink 1,001 Feet in Month

The long sought shaft sinking goal—more than 1,000 feet in one month—was reached in November 1959. The new world shaft sinking record was set by President Steyn Gold Mining Company at its No. 3 circular shaft in the Orange Free State, Union of South Africa. The 26-foot diameter concrete lined round shaft was sunk 1,001 feet from 311 to 1,312 feet through sandstone, shale, Dwyka tillite, carbonaceous shale, and coal seams.

Pictured here are the men who played such an important part in making this record. From the left they are: S. Spiro, chairman of the board, President Steyn; H. MacConachie, chief consulting engineer for the Orange Free State gold mines of the Anglo American Corporation of South Africa, Ltd.; Robert Blair, consulting mechanical and electrical engineer for Anglo America; A. K. Richards, master sinker at the No. 3 shaft; and J. J. Caduje, chairman, Welkom village management board.

This was a proud accomplishment for Anglo American, its consulting engineers, and staff for Mr. MacConachie had predicted recently at the Olympia Symposium in London, England that the South African sinking rate would exceed 1,000 feet per month (MINING WORLD, October 1959, page 40). Anglo American is the consulting engineer for President Steyn.

The staff of 31 Europeans and 419 Basutos broke and hoisted 53,215 tons of rock in the month, drilled 100 rounds of holes, and blasted some 21,500 holes with 51,850 pounds of dynamite.

Mr. Blair played an important part in the design of the Blair stage hoist used to position the 6-deck, 65-foot-long, sinking stage in the shaft. He also designed the cactus type mucking grab used for loading broken rock into the 10-ton sinking buckets.

A new method of handling broken rock on surface was used for the first time. The method incorporates two hydraulically operated sliding chutes which are moved inwards under the dumping buckets to receive the broken rock and transfer it to either of two 40-ton capacity surge bins built into the A-type steel headframe. The chutes are retracted to allow passage of the empty bucket back down the shaft. These chutes prevent spillage onto the collar doors; especially of fine muck which falls into bins when chutes are retracted.

Eight concentric rings of holes 10 feet deep were drilled and blasted for an average advance per round of 9.9 feet. The best advance per round was 11 feet. Average advance was 33.4 feet per day with the best day's progress being 40 feet.

The average cycle time per round was 6 hours and 41 minutes distributed as follows: ventilation, 30 minutes; lowering stage, 10 minutes; mucking, 202 minutes; cleaning bottom, 30 minutes; drilling, 84 minutes; and loading and blasting, 45 minutes. The shortest cycle was 5 hours and 27 minutes.

Concrete lining was placed for 963 feet from a depth of 302 to 1,265 feet during the month. Pours behind steel forms

were made in 20-foot lifts using a special fast setting concrete which was mixed on surface and dropped to the distributor on the stage through two 6-inch steel pipe lines.

An equally impressive record was set by Vaal Reefs Exploration and Mining Company in the same month when it sank its No. 2 circular shaft 954 feet to a total depth of 3,756 feet. This was the world's record shaft during October only, as its world record of 922 feet set in September was broken by both President Steyn and Vaal Reefs.

Vaal Reefs, while it didn't achieve quite the footage, nevertheless broke and hoisted 57,157 tons—3,942 more than did President Steyn. And Vaal Reefs started the month much deeper than the other shaft finished. The greatest difference between the two shafts being the shorter round; 7.34 feet average at Vaal Reefs. This necessitated 130 cycles versus 100 at President Steyn. The average cycle time at Vaal Reefs was 5 hours and 15 minutes with the shortest being only 4 hours and 28 minutes. Vaal Reefs used a few extra men; a total of 48 Europeans and 448 Basutos.

Thus the shaft sinking science reached an all-time peak in South Africa when the world's record was broken twice in one month and the magic goal of 1,000 feet was passed. Mr. MacConachie's London prophecy for 1,000 feet came true, and it is most likely that his additional prophecy that such footage each month will be a standard procedure very well may come true when one remembers that the world's record was only 667 feet in March 1955.

Queensland Deposit Could Make Mesabi Range Small

Iron ore deposits discovered recently in Queensland by Broken Hill Proprietary Company Ltd. could "make the Mesabi Range look small", according to local engineers. The deposit is believed to be that at Constance Range (18° 35' S., 138° 25' E.), not far from the Northern Territory border. The Broken Hill firm, headquartered in Melbourne, has been investigating these deposits and others at Roper Bar, reputedly low grade, since 1957. The company does not usually make public statements about its activities, except for releasing routine production figures.

Broken Hill began iron ore production in 1958 at its Iron Baron property near Whyalla on Spencer Gulf in South Australia, after a £A1,300,000 expansion project including new equipment and improvement of transportation facilities. The Iron Baron property and the adjacent deposit at Iron Prince were first developed in 1933.

In 1958, Broken Hill also announced plans to start construction this year on a £300,000,000 steel plant at Whyalla, including a separation plant at Iron Knob for concentrating iron ore from jaspelite. Initial plans call for a plant about one-third the size of that in Newcastle, with a production capacity of 300,000 tons of steel yearly.

ONTARIO—**Violamac Mines Ltd.** has purchased a 750-ton flotation plant to bring into production its **Kam-Kotia** copper-zinc property, west of Timmins, in the Porcupine camp. Preparation of the site is now under way and copper production is expected to start by the end of August. The company's decision for immediate construction of the mill followed discovery of what appears to be a third and completely unknown ore body at depth. Latest drilling, in a vertical hole, cut two new sections below the "A" ore body, which give 2.88 percent copper and 4.57 percent zinc over 11.4 feet, from 376.8 feet to 388.4 feet, and 1.28 percent copper and 4.22 percent zinc over 20.5 feet from 449.5 feet to 470.8 feet. The latter section included 10 feet of 1.67 percent copper and 4.5 percent zinc. Violamac will also provide for a daily crushing capacity of 1,000 tons to increase the overall milling rate later. Mining will be open-pit for the first three or four years. A recent geophysical survey outlined a large anomaly about 1,400 by 200 feet lying about 200 feet southwest of the "A" ore body and known as the "B" zone.

QUEBEC—**Mattagami Lake Mines,** which has been staffed and managed by **Noranda Mines Ltd.,** one of three firms to finance it, has become an independent organization. First plans in the new setup involve a program of underground development, which will probably be followed by construction of a mill and, later, a smelter. A contract has been let to Patrick Harrison Ltd. for sinking of the shaft, which will be a six-compartment opening with outside dimensions of 19.1 by 14.5 feet. It will be sunk to 1,200 feet, taking it well below the bottom of the ore bodies as presently outlined. Although open pit mining was at first considered, a study showed soil conditions to be unfavorable at the initial stage. Metallurgical studies of the ore indicate that fine grinding will be necessary, but no major technical difficulties in producing satisfactory zinc and copper concentrates are expected. The copper concentrate will contain about 35 percent of the gold and 30 percent of the silver in the mill heads. Investigation of refining methods indicate that electrolytic refining would be most suitable, with a proposed refinery that could produce 200 tons daily of special high grade zinc, 385 tons of sulphuric acid and substantial amounts of refined cadmium metal. Location of the mill and smelter is still being studied, but the probable site will be one on the north shore of the St. Lawrence River.

ONTARIO—**Algom Uranium Mines** is conducting deep development work at both the **Quirke** and **Nordic** mines that is opening better than average grade ore. Operating costs at both have been reduced during the last year. Deep work at the Quirke mine is on the 7th, 8th, and 9th levels, with workings now at a depth of about 1,220 feet. About 4,000 feet of ore on strike has been developed on the 7th level, with above-average grade. Deepening of the shaft to about 1,320 feet at the Nordic mine opened the 6th, 7th, 8th, and 9th levels and grade of the ore seems to be improving with depth. Cutting of a new underground crusher station and work on ore and waste pass extensions has been completed.

BRITISH COLUMBIA—**Cassiar Asbestos Corporation Ltd.** reports that 5,000,000 tons of high-grade asbestos ore have been developed at its **Clinton Creek** property and option to purchase this property will be exercised in full. An expansion of the Cassiar mills, completed in January, will increase its capacity to 1,500 tons a day. A substantial increase in ore reserves is indicated by work this last year in the adit on the 5,700-foot level, 300 feet below the first adit and 600 feet below the outcrop. Ore from underground exploration, being milled and tested on a production scale, is of similar grade and quality to that mined on the surface. Purchase and use of additional equipment will result in increased mining and stripping next season.

QUEBEC—**British Titan Products (Canada) Ltd.** has purchased a site at Sorel, Quebec, for construction this spring of a $16,000,000 titanium-pigment factory. The new facility will be located near **Quebec Iron & Titanium Corporation,** which will supply some 15,000 tons of raw material for the operation. The latter company has completed its $16,000,000 expansion at Sorel where six furnaces are now operating. Quebec Iron is mining a 125,000,000-ton deposit of ilmenite at Allard Lake on the lower St. Lawrence River and is expected to be able to supply both **British Titan** and **Canadian Titanium Pigments,** which operates a $15,000,000 plant at Varennes, Quebec.

BRITISH COLUMBIA—Preliminary estimates of mineral production in this province for 1959 indicate a total value of some $7,000,000 more than 1958. Significant increases are shown for silver, copper, iron, by-product metals, asbestos, sulphur, and gypsum, offsetting declines in gold and lack of tungsten production.

ONTARIO—An agreement that marks the start of a $15,000,000 program to develop mineral and forestry resources and recreational areas in northern Ontario was signed recently by province and Federal officials. The project calls for construction of six roads, with a total length of 335 miles, and envisages building other roads when surveys are completed. Ontario roads covered by the program include those from Foleyet to Chapleau, 60 miles; Nakina to Cavell to Durer Lake, about 50 miles connecting **Anaconda Iron Ore Company** roads and ore deposits near Melchett Lake and west of Percy Lake; Goldpines to Uchi Lake, about 50 miles, a mining development road, and Minaki south, about 15 miles, aimed at opening up mineral resources. The major project, not yet decided definitely, will be in the northwest, exact location to be determined by aeromagnetic survey and geological ground reconnaissance.

BRITISH COLUMBIA—The market for British Columbia iron ore in Japan may double or triple in the next several years. Current contracts with four exporters will gross about $30,000,000 and are running about $7,000,000 annually. Development of new properties, along with

Unveil Lundberg Gravity Gradiometer

The world's first airborne gravity gradiometer, unveiled and demonstrated in Canada recently, is now being shown in countries throughout the world. Developed in the Toronto research laboratory of Lundberg Explorations Ltd., the gradiometer has already proved effective in major aerial surveys throughout North and South America and Africa. The classified instrument will be a vital aid in the search for essential minerals, oil and gas by providing fundamental gravity data revealing geological structure. The device was demonstrated recently at the First International Symposium of Arctic Geology in Calgary, Alberta. When the gradiometer was flown to Calgary from Toronto in a survey aircraft, it recorded changes in the earth's gravity in the Precambrian shield and across the sedimentary basin of Western Canada. In the picture above John B. McClusky receives these gravity records from Lloyd Leach, chief of Lundberg Explorations' laboratory where the instrument was developed. Wally Hobbs, chief company electronic technician, holds the gradiometer. Mr. McClusky, Lundberg marketing engineer who assisted in the final development of the instrument, is assigned to explain its applications to geologists around the world. Paris, Stockholm, Mexico City, Houston and New Orleans are among cities scheduled for demonstrations.

research in Japan on the low-grade British Columbia ore, may increase this figure substantially. Current exporters are **Texada Mines, Empire Development Company Ltd., Hualpai Enterprises Ltd.,** and **Nimpkish Iron Mines Ltd.** All properties under development are on Vancouver Island.

BRITISH COLUMBIA—Reactivation of a potline at its Isle Maligne smelter will increase production by 22,000 tons yearly for **Aluminum Company of Canada Ltd.** An additional 12,500 tons annually will be smelted by reactivating pots at Alcan's Kitimat and Shawinigan smelters. On completion of the increase, the annual production will be raised to 595,000 tons yearly, or about 77 percent of the installed smelter capacity of 770,000 tons per year. Earlier the company had upped production to 560,000 tons a year.

HAWAII—A progress report on the investigations of bauxite deposits in the eastern part of Kauai, Hawaii, is now available in open files for consultation. Written by S. H. Patterson, the 12-page report is on file with the Ground Water Branch, Geological Survey, Room 333, P.O. Building in Honolulu; at the University of Hawaii Library in Honolulu; and at United States Geological Survey Libraries in Washington, D. C.; Denver, Colorado, and Menlo Park, California.

QUEENSLAND—**Mount Isa Mines Ltd.,** Mount Isa, will expand exploration in northern and central Queensland this year. After the wet season (about April) geologists and drillers will investigate at least five areas "to see just what the ground contains." Major copper discoveries in northwestern Queensland are considered possible since the Cloncurry area was Australia's most important copper province at the start of this century.

INDONESIA—A contract that calls for exporting 800,000 tons of bauxite from the Bintan Islands to Japan during the next two years is the first such agreement signed by Japanese firms to cover more than one year. The agreement between three leading Japanese aluminum refineries and a state-controlled mineral trading company covers nearly one-half of Japan's annual requirements for bauxite for aluminum production, running at about 800,000 tons annually. According to the Japan light Metal Refining Association, the order calls for ore with 53 percent alumina content. Japan also imports bauxite from Malaya, Sarawak, and West Borneo.

REPUBLIC OF THE PHILIPPINES—Increased earnings—Pesos 460,939.56 over the previous year—are reported by **Philippine Iron Mines** for the fiscal year ended September 30, 1959. Total deliveries of iron ore in that period were 1,046,714 dry metric tons compared with 919,650 the year before. From the company's Mati property, operated by **Atlas Consolidated Mining and Development Corporation,** 183,087 tons were delivered **to Japan Steel Mills.** A new contract with the Japanese firm calls for delivery of 960,000 metric tons of ore between April 1, 1959 and March 31, 1960. Combined production of surface and underground mines presently averages 40,000 tons of lump ore and 50,000 tons of sinter feed ore monthly. With a total ore reserve of 36,000,000 tons, mining operations are expected to continue another 25 years, according to Ramon J. Fernandez, board chairman.

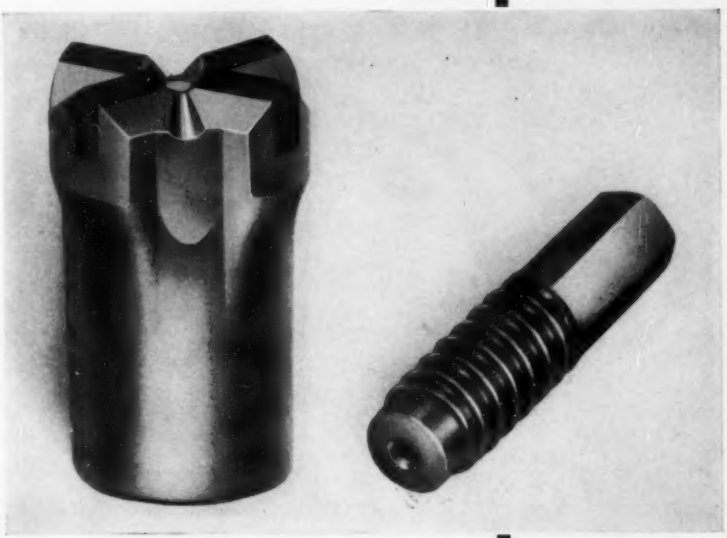
WESTERN AUSTRALIA—Ore reserves at **Lake View and Star Ltd.,** Fimiston, show an increase, despite record milling tonnage in the last year. The treatment plant put through 753,857 tons, which was 10,408 tons more than in the previous year. Recovery of gold increased by 3,198 ounces for a total of 163,721 ounces. Reserves are now at 3,575,000 short tons, averaging 4.85 dwts. per ton.

NORTHERN TERRITORY — **United Uranium N. L.** has completed exploration from No. 1 adit at **Coronation Hill.** The ore body, which is over 32 feet long and 48 feet wide, assayed 10.4 pounds of uranium oxide per ton and also 5.04 dwts. of gold. The company has sunk a winze 50 feet below the adit for further examination.

VICTORIA — **North Deborah Mining Company N. L.,** Bendigo, will prospect on leases near the township of Gordon which were held by **Gordon Gold N. L.** some 20 years ago.

TASMANIA — An increase in output from 12,000 to 16,000 tons yearly is planned at the Bell Bay aluminum plant of the Australian Aluminum Production Commission. Bauxite is supplied by Indonesia, the Philippines, and India.

NEW SOUTH WALES—Varying production records were reported by **Broken Hill** silver-lead-zinc mining companies during 1959. **Consolidated Zinc Ltd.** and its associate, **New Broken Hill Consolidated Ltd.** both produced more ore and lead. A decline in lead output for the last six months of the year was shown by **Broken Hill South.** In zinc concentrate production, Consolidated Zinc had a de-



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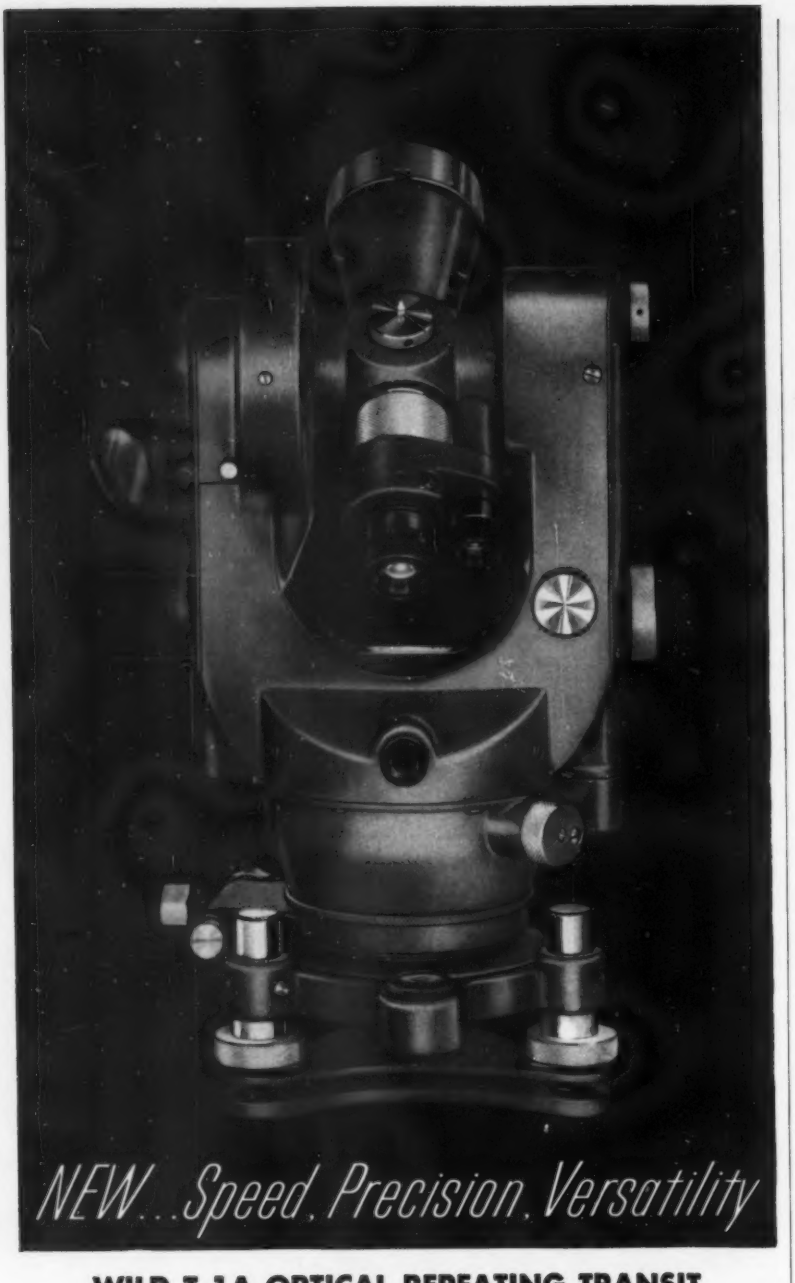

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creased output, New Broken Hill an increase of about 9,000 tons, and Broken Hill South a decrease from 35,319 tons in 1958 to 24,858 tons this last year.

NEW SOUTH WALES—Production of rutile from Australia's east coast (northern New South Wales and southern Queensland) is running about 18,000 tons per quarter year. Zircon output is about the same rate, with producers tending to produce higher grades by means of more efficient cleaning equipment. **Wyong Minerals Ltd.** at Wyong, sponsored by **Commonwealth Mining Investments Ltd.**, has begun production on a small scale, but contracts for forward delivery have not been up to expectations. **National Minerals Ltd.** at Newcastle expects to operate a new dredge early this year. **Associated Minerals Consolidated Ltd.**, rutile and zircon producer, has too few orders to keep its large concentrator in full operation.

NEW GUINEA—**Bulolo Gold Dredging Ltd.** had a net profit of $687,693 or 69¢ a share for its last fiscal year, compared with the previous year's profit of $403,005, or 40¢ per share. For the current year, during the first six periods of four weeks each, the dredging and sluicing operations handled 2,673,500 cubic yards of gravel, recovering 11,159 ounces of fine gold, with a value of $390,565. The company has constructed a new pipeline to improve working pressure for the sluicing operation with the result that yardage handled for the current six months is twice that for the same period last year.

NORTHERN TERRITORY—Increase in production of copper up to 9,000 to 10,000 annual tons is planned during 1960 by **Peko Mines N. L.**, which will ship half the output to Japan. The shaft at the **Orlando** gold prospect has reached the 420-foot level and drifting is proceeding.

NEW GUINEA—Reports indicate that the **Mount Victor** ore body being drilled by **King Island Scheelite N. L.** is about 70,000 tons, assaying 4.7 dwts. gold. Drilling continues in the western extension, but underground development has ceased.

WESTERN AUSTRALIA—The **Imperial** mine near the southern end of Kalgoorlie's Golden Mile will be reopened by **Lake View and Star Ltd.** of Fimiston, Australia's leading gold producer. Recent geological mapping indicates the possibility of undiscovered ore bodies at the mine, originally worked to only 100 feet. Ore will go to the Lake View mill for treatment.

NEW ZEALAND—Excellent production, combined with low costs, is being achieved by the west coast dredges of **Gold Mines of New Zealand Ltd.** (**Arahura Gold Dredging Ltd.**, Arahura, and **Kanieri Gold Dredging Ltd.**, Taramakau). The Kanieri dredge, making one of the best records in many years, in November handled 306,000 cubic yards in 501 hours to produce 2,223 ounces of bullion. Dredge operating cost is about £100,000 (New Zealand) per year. Output for the current year, starting in April, is already over 11,000 ounces, valued at £132,000 (N.Z.). The Kanieri property has about eight years of reserves, but that at Arahura will be exhausted in about two years.

FRENCH GUIANA—Mining of the Kaw bauxite near Cayenne is scheduled to start soon by the recently formed **la Societe Guyanaise des Bauxites.** The new company, a joint venture of **Kaiser Aluminum and Chemical Corporation** of the United States (90 percent) and the **Bureau Minier Guyanais,** has an option to mine until December 31, 1960. Plans call for exporting the ore in bulk for processing into alumina in the United States. However, part of the product may be used for needs of industry in France.

CHILE—**Noranda Mines Ltd.** of Canada has been investigating an area in the Paposo district about 100 miles south of Antofagasta, and inland, where there were formerly copper mining operations. The examination, under options and as part of Noranda's usual outside exploration activities, is based on the possibility that there may be material economically treatable at present, although the higher grade was removed several years ago. Last year Noranda purchased a copper mine in that general area from **Sociedad Latorre Prenafeta** of Antofagasta for over $500,000.

PERU—To provide an adequate supply of drinking water for the **Marcona Mining Company,** water is being shipped in from Gatun Lake, Canal Zone. Ships going to San Juan to load iron ore pick up about 4,000,000 gallons of water to use as ballast while traveling through the lake. Water is discharged at San Juan into storage tanks that hold a 45-day supply. Marcona has built two large reservoirs of 3,000,000 gallons capacity.

MEXICO—Silver mines in the area of **Minas San Nicholas** in Jacala, State of Hidalgo, may be reopened following a geological survey undertaken by Ing. Salvador Pena Slane, Undersecretary of Recursos No Renovables. Initially the ore will be processed at the Loreto mill of **Cia. Real del Monte** in Pachuca. A concentrating plant may be built if ore supply is sufficient.

COSTA RICA—**International Iron, Inc.,** a newly formed company headed by A. W. Dugan of Houston, Texas, has announced discovery of a previously unknown iron deposit on the West Coast of Costa Rica in the Province of Guanacaste, several miles from the Pacific Ocean. The American company has been conducting an exploratory operation with National Exploration de Costa Rica for several months. This is the first report of iron ore in the area. Assays have been as high as 65 percent FE, although the major portion of the indicated ore would require beneficiation.

MEXICO—**Cia. Minera Autlan** is starting exploration on manganese properties acquired recently in Huaclilla, State of Oaxaca. Preliminary work shows the property to be promising.

COLOMBIA—**The Colombia Emerald Company** (Empresa Colombiana de Esmeraldes) will be organized this year to operate the **Muzo** and **Cosquez** mines,

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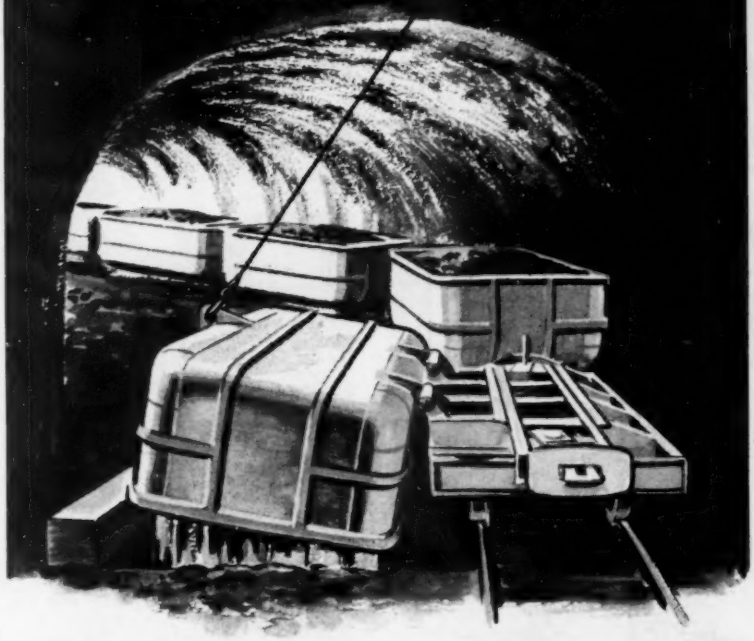

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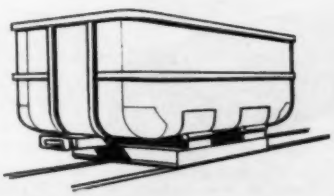

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formerly operated by the Central Bank (Banco de la Republica) for the government. These two mines produce 95 percent of the world's output of emeralds. Formation of the new company, organized with government and Colombian and foreign private capital, was authorized by the Congress last year to encourage free enterprise. Previously the emerald business was a government monopoly.

MEXICO—Tin deposits in states of Durango, Zacatecas, San Luis Potosí and Aquascalientes have been located by Consejo de Recursos No Renovables. The government is stressing the importance of increasing tin production since this country consumes 1,200 tons yearly, but produces only 400 tons.

CHILE—A $70,000,000 expansion of its Huachipato steel plant near Concepcion has been started by the **Cia. de Acera del Pacifico.** The plant used nearly 500,000 tons of Chilean iron ore last year, handling most domestic steel product needs and exporting 75,000 tons to Argentina and smaller amounts to Peru and the United States.

MEXICO—Santiago Ochoa Carriedo has discovered an extensive molybdenite deposit in the municipality of Manuel M. Dieguez in the state of Jalisco. The major outcrop is about 15,000 feet long. Deposits are of the manto type. A 42-mile road has been built to the property, and a drift has been driven into one of the mantos. Plans for a small concentration plant are under study by the owner.

MEXICO—A 100-ton-per-day pilot mill was scheduled to start operation last month at **San Francisco Mines of Mexico Ltd.** located in San Francisco del Oro, Chihuahua. The mill will recover by flotation the fluorspar in the lead-zinc mill tailing. Test work was conducted by **The Galigher Company** of Salt Lake City, Utah. Sampling of the San Francisco tailing has shown it to average 15 percent fluorspar.

DOMINICAN REPUBLIC—A pilot plant for extracting nickel from the Cibao region is scheduled to be built in the next few months by a subsidiary of **Falconbridge Nickel Mines Ltd.** Surveys indicate ore reserves in the area are about 100,000,000 tons.

COLOMBIA—A contract to supply management assistance to **Acerias Paz del Rio, S.A.,** has been announced by the engineering and construction division of **Koppers Company, Inc.,** Pittsburgh, Pennsylvania. Acerias Paz del Rio has an integrated steel facility with an annual capacity of 125,000 metric tons. Its plant at Belencito includes a blast furnace, coke ovens, several rolling mills, and an 18-ton electric furnace. Raw materials—coal, limestone, and iron ore—are mined within a radius of 25 miles of the plant, which is 145 miles northeast of Bogota at an altitude of some 8,500 feet.

CHILE—**Cia. Salitrera de Tarapaca y Antofagasta,** a Santiago industrial firm with a nitrate mine and plant at Victoria, Chile, has made a management assistance contract with the engineering and construction division of **Koppers Company,** Pittsburgh, Pennsylvania. The Chilean firm is primarily a nitrate producer but also has interests in phosphates, iron ore, and timber. Plant capacity is being increased to 18,000 tons per month of nitrate, used principally in fertilizers and chemical products.

MEXICO—At the annual convention of the **Federation of Mining Associations** in December 1959, the opening speech was given by Lic. Eduardo Bustamente, minister of Patrimonio Nacional, who announced that a law before Congress provides for tax relief to the miner in order to foster new mining investments. He said that although the government desires that mining development be primarily in the interests of Mexico and Mexicans, this does not mean that foreign investors operating within the law and willing to cooperate in mining development of the country be denied access to investments. Other convention highlights included a visit to the Pachuca silver mining district.

BRAZIL—Construction of the **Companhia Siderurgica Lagoa da Prata** steel plant in Minas Gerais was completed recently. Capacity of the new facility is 25 tons of pig iron daily.

MEXICO—After three months of operation, the Santa Julia mill erected by **Comision de Fomento Minero,** a government agency designed especially to aid the small miner, is doing better than expected. Installed to float tailing from the Loreto mill of the **Real del Monte** mines at Pachuca, Hidalgo, the mill is designed to handle 10,000 tons daily. Present throughput is 9,000 tons per day, running an average of $1.37 per ton in silver. Recovery of silver found in pyrite is about 50 percent.

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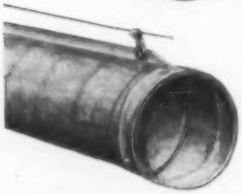

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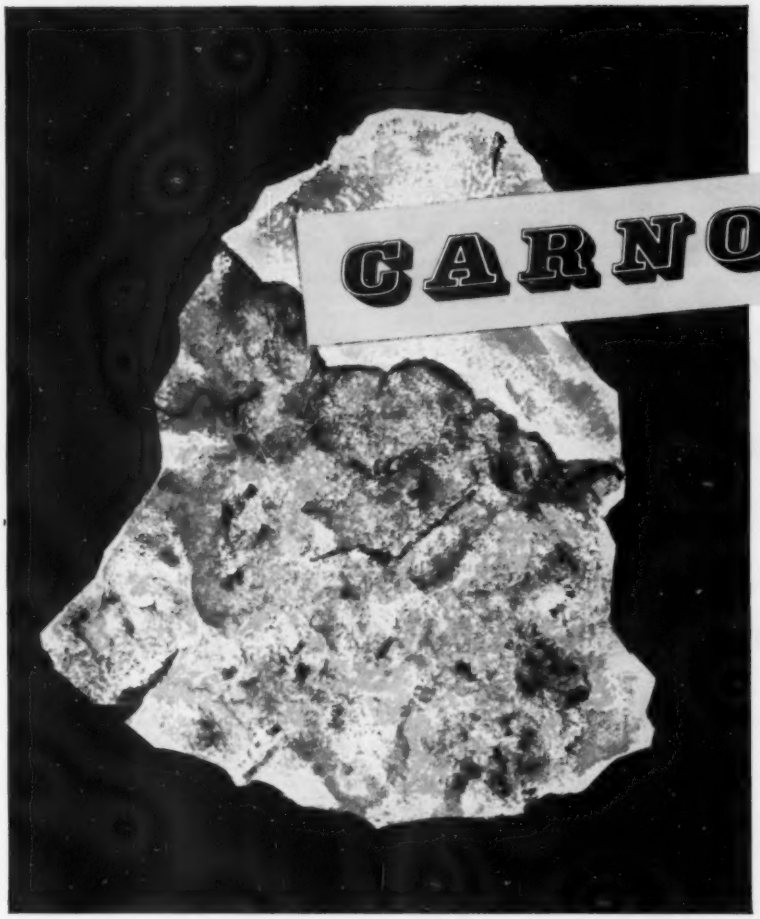

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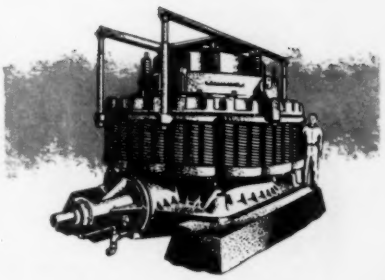

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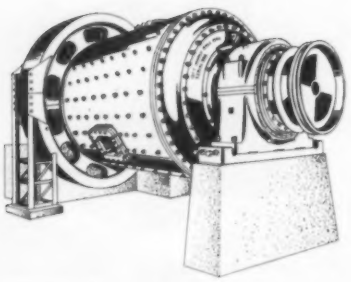

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FEDERATION OF RHODESIA & NYASALAND—**Messina (Transvaal) Development Company Ltd.** is continuing development work at its **Alaska** mine near Sinoia in Southern Rhodesia, where a copper smelting and refining plant is being built. The £750,000 plant, scheduled to be in operation by next October, will treat concentrates from Messina's Alaska and **Mangula** mines. At the Alaska deposit over 5,000,000 tons averaging 1.8 percent copper has been proved.

UNION OF SOUTH AFRICA—Deep-level operations at **East Rand Proprietary Mines Ltd.** now extend into the extreme eastern section where the Far East subvertical shaft has intersected the Composite Reef at 8,897 feet below surface. A small footage sampled there averaged 126 inch-dwts. Immediately north of the shaft, in a pay-shoot zone, a deep level cross-cut has intersected the same reef about 2,440 feet from the shaft, with values of 446 inch-dwts. over 46 inches. Construction of the new gold plant with an eventual monthly capacity of 170,000 tons is proceeding on schedule.

FRENCH WEST AFRICA—Alluvial gold has been traced in the headwaters of the Wago River in eastern Sierra Leone, by a British mining company, not identified at present. Laurite, (RuSz) a rare mineral, has also been indicated in the Guma Valley.

GHANA—A £450,000,000 loan, without interest, from the Ghana government is expected to enable **Amalgamated Banket Areas** to enlarge gold reserves and install new equipment to reduce operating costs.

UNION OF SOUTH AFRICA—Orders for shipment of manganese ore in 1960 are reported to be considerably higher than the tonnage sold in 1959. **Associated Manganese Mines of S.A. Ltd.** expects exports to reach about 270,000 tons this year, but at lower prices than previously.

REPUBLIC OF GUINEA—A survey of large iron ore deposits will be started here soon by **Kinoshita Shoten** of Japan, and the **Guinea American Development Corporation,** which has a 70-year concession to mine iron deposits. The joint venture is aimed toward developing the mines for United States and Japanese steel industries. Location of the deposit is at the Nimba mines near the border of Liberia, where reserves of 25,000,000,000 tons have been estimated by W. H. Patmore, Princeton University professor who made a preliminary investigation. Kinoshita Shoten is a leading Japanese trading firm that was previously interested in iron reserves in India.

GABON—Extensive research at the **Mounanan** deposit of uranium and vanadium ore has disclosed reserves that warrant the start of mining in 1961 and construction of a beneficiating plant. Reserves are now estimated at 20,000,000 tons, containing 4,000 to 5,000 tons of uranium. The project will be operated by a new company, **la Compagnie des Mines d'Uranium de France-Ville,** formed by **la Compagnie des Minerais de Fer Magnetique de Mokta-El-Hadid; la Compagnie Francaise des Mineraise d'Uranium,** and the **Commissariat a l'Energie Atomique de France.** The beneficiating plant is scheduled to produce concentrates containing 15 percent uranium, which will go to France for treatment. Future plans include building a new mill in Gabon, where the percentage of concentrates will be increased to 60 percent.

MADAGASCAR—**La Societe de Traitement des Sables du Sud de Madagascar (Sotrassum)** has opened a pilot plant to study equipment for production of ilmenite, monazite, and zircon. The plant includes a gravimetric wet treatment system, which produces quartz-free concentrates which are dried and then sorted magnetically to obtain concentrates of commercial value. Production capacity of the project is 30,000 tons of ilmenite, 1,000 of monazite, and 1,500 of zircon per year.

FEDERATION OF RHODESIA AND NYASALAND—At **Mulfulira Copper Mines Ltd.,** more than 53,000,000 tons of additional ore reserves have been blocked out over the past three years. This tonnage has been discovered by drilling and underground development in the western part of the mine. Exploration work is being continued and the date of completion of the mine's expansion program is mid-1962, when it is expected that the production capacity will be increased by 50 percent.

UNION OF SOUTH AFRICA—**The Consolidated Gold Fields of South Africa Ltd.,** the parent firm for **West Witwatersrand Areas,** expects that its surface drilling of an area of 86,400 claims will take about two years to complete. The area being prospected is south of the West Witwatersrand Areas below the present line of mines from **Libanon Gold Mining Co. Ltd.** to **Doornfontein Gold Mining Company Ltd.**

SOUTHERN RHODESIA — **Bikita Minerals (Private) Ltd.** has purchased the large high-grade petalite property adjoining its lepidolite deposit. Previously owned and operated by George H. Holan, it forms part of the same pegmatite ore body now being mined by Bikita but has large reserves of petalite as well as subsidiary spodumene and eucryptite, whereas the other section contains primarily lepidolite and beryl, with subsidiary spodumene, amblygonite, and pollucite. The two properties can readily be worked as a single mining operation, enabling the company to supply all types of lithium ore. **Selection Trust, American Metal Climax, Inc.,** and **American Potash & Chemical Corporation** are shareholders in Bikita Minerals.

UNION OF SOUTH AFRICA—**South Roodepoort Main Reef Areas Ltd.** has applied for mining rights over about 160 claims north of its lease area following encouraging exploration. Prospecting continues.

MAURETANIA—The present economical fate of this country, which became a republic within the French community in October 1958, seems to hinge on the development of the (63 to 67 percent) iron ore deposit near Fort

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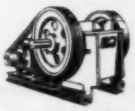

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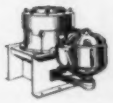

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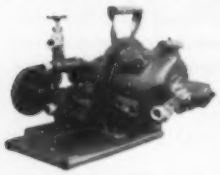

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INTERNATIONAL

Gouraud. **The British Iron and Steel Corporation (Ore) Ltd.** has a 20 percent interest in the venture and Germany and Italy are also taking part. Cost of developing the area, which is on a hill 1,000 feet high and 80 miles long, is estimated at $60,000,000. Transportation presents a large difficulty since the area is 400 miles from the nearest French port. The Spanish territory of Rio de Oro on the west seems uncooperative, so the railway will have to be built to Port Etienne. Present plans indicate 20,000 tons of ore could be mined daily with shipments leaving the area by train every 12 hours. Reports indicate that a V-shaped valley could be carved into the mountain and the deposit would then be easy to mine. Half of the profits from the mine if it is developed will go to the Republic of Mauretania. Although getting indigenous labor presents no problem, it may be difficult to employ skilled European technicians since this area is bleak and inaccessible.

UNION OF SOUTH AFRICA—The recently completed mineral survey of the holdings of the **Staltzburg Asbestos (Chrysotile) Holdings Ltd.** disclosed very large reserves of short fibers. Indicated recovery is about 0.5 percent for low No. 4 grade; 1.75 for Nos. 4 and 5; and above 2.0 for No. 6. However, until No. 6 prices improve, operations will remain unprofitable so the mine continues on a caretaking basis.

EIRE—Laboratory tests on the barite ore mined by **Silver Mines Lead and Zinc Company Ltd.** of Shallee, County Tipperary, show that flotation will remove sulphide minerals so that ore is upgraded to 93 percent barium sulphate. The company has undertaken a limited diamond drilling program, as well as a gravimetric survey that resulted in about 500,000 tons of barite ore averaging 88.4 percent barium sulphate being proved. A further 1,000,000 tons of ore have been indicated.

SWEDEN—In February **Stallbergsbolagen** began developing a new mine in the **Wassman** district where shaft sinking and diamond drilling will take about two and one-half years. Shaft sinking has also been resumed at **Klara-field.** At the company's operation in **Idkerberget** a new crushing plant at the 700-meter level has been in production for several months.

RUSSIA—According to The English Firm, **Diamond Corporation, Ltd.** all diamonds from the U.S.S.R. which Soviet authorities wish to export for marketing in the West will be purchased by Diamond Corporation and sold through the central selling organization of the **De Beers** group. Most of the Russian output will come from the Yakut A.S.S.R. area where 98 percent of all the country's diamonds are located. Before 1939 only a few diamond deposits, in the Urals centered in the Perm Region, were known. Diamonds were first discovered in Siberia (Yakut) in 1949 in the Vilyi River bed, where large discoveries have been reported since then. It has been re-

ported that three mines, each producing between 1,000,000 and 2,000,000 tons of diamond ore yearly, are currently being brought into production in this area.

SWEDEN—**Riddarhytte A. B.,** which is undertaking a three-year modernization program, has sunk its new shaft to the 350-meter level and will sink to the 470-meter level. The expansion includes a new headframe, a crushing plant at the 420-meter level, and a new sorting and concentration plant, all scheduled to be in operation in 1961. Production capacity will then be increased to over 400,000 tons of iron concentrate yearly.

POLAND—Production at a new iron ore mine, **Wreczyca,** is scheduled to start early this year. One of six iron ore mines now under development in the Czestochowa-Klobuck and Leczyca districts, the plant will have an annual production of 240,000 metric tons when in full operation. The **Malice** mine near Czenstochau, with a yearly capacity of 220,000 tons, will start production next year. Expansion of mining in Poland to aid the iron and steel industry includes plans to begin output from a new mine each year starting with 1961, so that by 1965 output will be increased by some 40 percent over 1959. During last year production amounted to about 2,000,000 tons, of which 1,300,000 tons came from mines developed after World War II. Since 1947, 12 mines have been commissioned in this country.

RUSSIA—A report from Tass, the Soviet News Agency, indicates that a deposit of chromite with a high nickel content has been discovered near the town of Serov in the Ural Mountains.

WEST GERMANY—**The Arbeitsgemeinschaft Ferromagnetismus,** jointly founded by three technical research associations, the **German Society for Metallurgy,** the **Verein Deutscher Eisenhuttenleute,** and the **Deutsche Physikalische Gesellschaften,** serves to promote the special field of magnetism. The scientists are employed in problems of fundamental research, technical development, and problems of industrial application. To carry out this program, 70 German specialists work in five research groups. The specialists are in regular contact with experts from other countries exchanging ideas and findings. Each year a volume is published as the "Reports of the Ferromagnetism Team." The 1958 volume has just been published with 24 papers given at the annual meeting which was held at Dortmund, West Germany on September 27 and 28, 1959. This volume will contribute to the knowledge of magnetism and it is hoped will inspire the specialists to an intensive exchange of ideas.

YUGOSLAVIA—Increasing production of graphite is reported from the **Slavonski Rudnici Nemetala** mine in Pakrak, which produced about 1,300 tons in the first nine months of 1959. Final figure for the year is estimated at 1,600 tons. Construction of a flotation plant to raise the grade of the graphite is being planned.

UNITED KINGDOM—A wrought beryllium plant, the first in Europe, was completed recently by **Imperial Chemical Industries.** Cost of the new facility was about £1,000,000 and its capacity is between seven and 10 tons per year, with products priced at about £160 a pound. Keyed to plans for advanced gas-cooled reactors in which beryllium is used for fuel cans and ancillary reactor equipment, the plant employs about 200 persons. Because beryllium is processed in powdered form that is toxic if inhaled, the plant has no windows, and employees in the contact area wear protective clothing, including breathing apparatus. The air is filtered, heated, and exchanged every three minutes. Each week air samples are taken for further precautions. In addition to nuclear energy uses, beryllium alloys are being developed for guided missiles and guidance systems. Imperial Chemical's first venture into the field of new metals was its titanium plant at Swansea which now produces ingots weighing up to two tons.

SPAIN—In Andujar, (province of Jaen), all mineral wealth except hydrocarbons has been reserved for the State, with prospecting and exploration under direction of the Nuclear Energy Board. The ore-dressing plant for uranium ore at Andujar is scheduled to start production soon. Large scale potash mining reportedly will begin shortly in the El Perdon zone near Pamplona. Mining men in the province of Huelva have formed an association, **Manganesos de Huelva,** for buying and selling purposes. Import restrictions have been lifted on some ores, affecting particularly the manganese miners whose high costs make competitive pricing difficult. Iron ore deposits have been found near Pena de Haya on the French frontier.

YUGOSLAVIA—Expanded prospecting plans for 1960 have been made by the Republic of Bosnia and Herzegovina where deposits of iron, bauxite, salt, coal, and mercury have been found previously. In West Herzegovina, further in Jajce, and between Vlasenica and Srebrenica, bauxite prospecting will be carried on. Development will continue at the **Tusanj** salt mines where production is scheduled to start this year. Research for iron deposits will go on in Ljubiga, in Prozor, Zavidovici, Bugojno, Jablanica, Kresevo, and Travnik. Depoits of mercury have been found in Drazevac, Cemernica, Gornji Vakuf, and Kresevo. Exploration projects are a joint undertaking of the **Federal Institute of Geology** and the **Institute of Geologic Prospecting of the Republic.**

TURKEY—Exploration of copper-pyrite deposits on the Black Sea coast is progressing. In addition to the long-known **Murgul** mine in northeast Turkey, near the Russian frontier, several other mineralized areas have been discovered by geochemical and geophysical prospecting. During the coming year an extensive exploration program will be carried out by the MTA Institute. Several million tons, which at times assays up to 3 percent copper, have been indicated by these surveys.

IRAQ—First metallurgical works to be built in this country will be constructed near Bagdad, with the aid of the U.S.S.R.,

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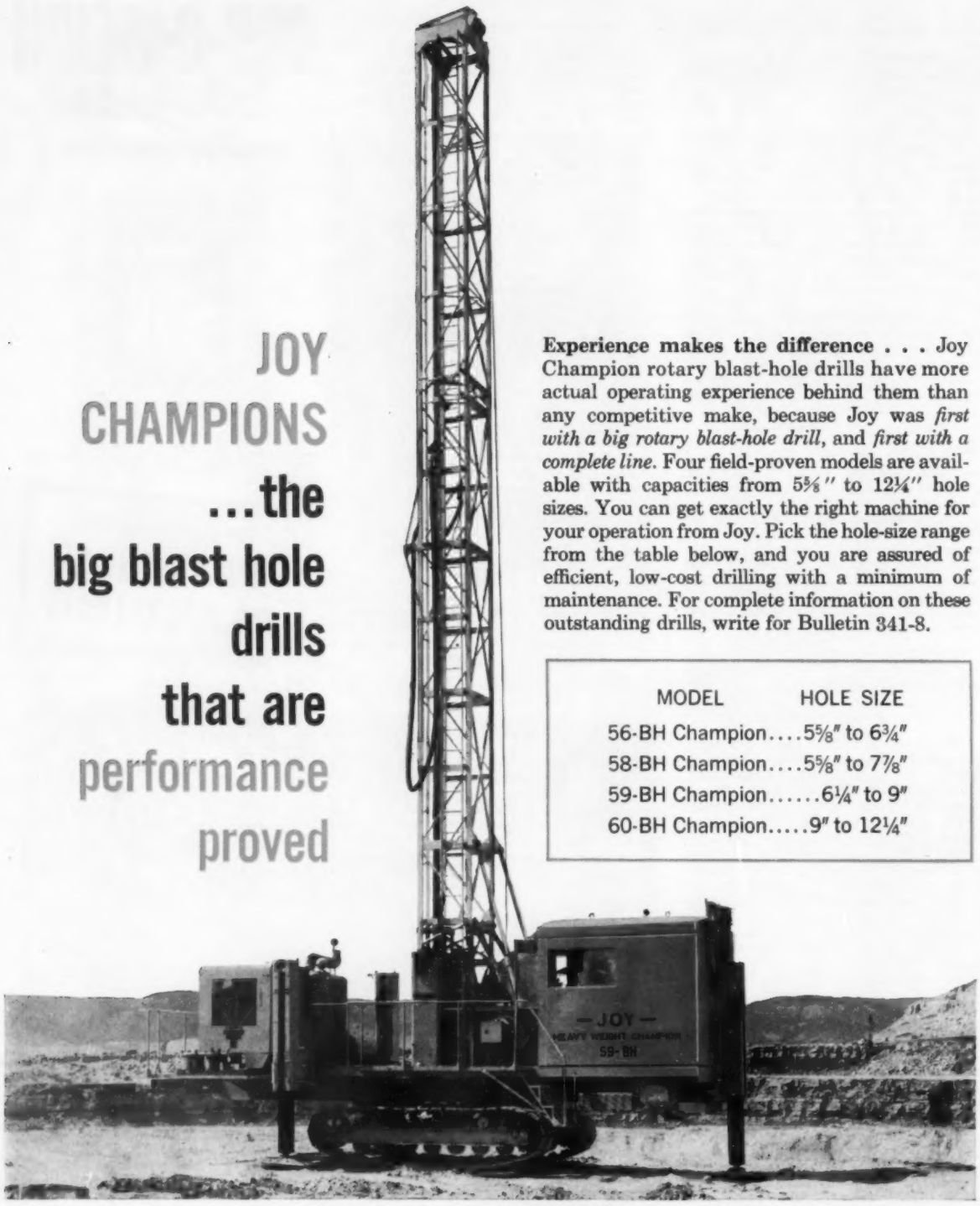

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58-BH Champion	5⅝" to 7⅞"
59-BH Champion	6¼" to 9"
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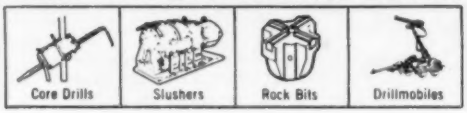

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according to the Soviet News Agency Tass. Soviet engineers have begun planning the facility which will provide about 20 percent of Iraq's ferrous metal needs. Scrap and iron mined at **Pendjavin**, where geological surveys are under way, will be used to manufacture building supplies, agricultural machinery, and cast-iron pipe. The U.S.S.R. will provide equipment for the steel plant.

BURMA—Output of the **Burma Corporation (1951) Ltd.** is expected to drop during the next few months, following a decrease of over 50 percent in profits—from £92,063 in the June quarter to £51,218 in the September 1959 quarter. Exceptionally costly mine repairs are said to be the cause of the profit loss for the lead-zinc-silver producer, a joint venture of the Burmese government and **Burma Mines Ltd.**

MALAYA—Reopening of some 60 tin mines here is expected early this year because of increased permissible exports for the ninth quota period of the International Tin Quota group. According to P. L. Milliar-Smith, chief inspector of the department of mines, prospects for the mining industry are excellent if the favorable quota situation continues. Many Chinese mines have been closed down since the start of tin control in 1957. About 41 of the mines to reopen are in North Malaya. The export quota for the three-month period ending March 31 is 13,590 tons, compared with the eighth period quota of 11,352 tons.

JAPAN—Six leading Japanese copper producers have concluded a long-term contract with **Mount Isa Mines Ltd.**, of Queensland, Australia, to import 72,000 tons of 25 percent copper concentrate, according to **Mitsui Bussan Kaisa Ltd.** Mount Isa, one of the main sources of Japanese copper, will deliver the tonnage during 1960.

INDIA—A four-day symposium on "Pilot Plants in Metallurgical Research and Development" was held last month at the National Metallurgical Laboratory in Jamshedpur. The meeting emphasized the value of undertaking pilot plant work in different aspects of metallurgical and mineral industries. Leading metallurgists and scientists from India and other countries participated in the symposium, which was divided into 12 sections covering many phases of the meeting's theme. Prof. M. S. Thacker, director-general of Scientific and Industrial Research, New Delhi, and Sir J. J. Ghandy, Kt., C.I.E., director-in-charge of **The Tata Iron & Steel Company Ltd.** and executive council chairman of the National Metallurgical Laboratory, were among speakers at the symposium.

KOREA—A one-year extension of the overseas sales contracts between the government-controlled **Daihan Tungsten Company** and the **Continental Ore Corporation** of New York has been approved by the Ministry of Commerce and Industry in Seoul. South Korea now exports about 300 tons of tungsten ore monthly to the New York firm. Proceeds from tungsten exports to the United States amount to at least $2,160,000 per year.

ISRAEL—The English firm **Baker Perkins Ltd. of Peterborough Ltd.** has signed an agreement with the **Ministry of Development** of the Government of Israel and **Israel Mining Industries** for the development of a process for mineral ore dressing based on the use of a heavy liquid, tetrabromoethane, known as T.B.E. This liquid, rich in bromine, is extracted from the waters of the Dead Sea by a new and economic process perfected by Israel Mining Industries. Baker Perkins has undertaken to design, build, and sell special equipment for ore dressing for the T.B.E. process and to market T.B.E. for use in these plants. It will install a test laboratory and demonstration plant in a new building at Letchworth, Surrey, England.

TURKEY—Greater development of the mineral resources of the Central Treaty Organization consisting of Iran, Pakistan, and Turkey, was urged during a five-day meeting of mineral experts from CENTO countries and the United States in Ankara recently. This program is necessary in order to improve the standard of living in that area, it was emphasized. The experts noted that mineral trade among the three CENTO countries is almost non-existent, but they concluded that development of trade in sulphur, lignite, lead, and bentonite merited further study. Chief obstacle to the development is lack of communications between the regional countries, the group agreed, urging speedy implementation of communication and transport projects.

MALAYA—The merger of **Sungei Besi** mines with the adjoining **Hong Fatt** mine (Mining World, November 1959, page 81) is expected to result in a project of considerable magnitude in the tin mining industry. The huge open-pit operation at Hong Fatt will be linked with two other pits at Sungei Besi and large-scale operations will probably reduce working costs. Besides the richer tin-bearing ground at Hong Fatt, the merger will make available high-grade ground at Sungei Besi's south pit. It will also increase, by nearly 60 percent, that mine's present output assessment under the International Tin Agreement.

BURMA—B. Oberman of Brighton, England, has made an offer to purchase all of the issued share capital of the **Consolidated Tin Mines of Burma Ltd.** and the company's directors intend to accept the offer. They have advised shareholders to do the same despite the fact that the prospective purchaser does not plan mining activities in Burma. During 1958 the company had a loss of £37,275 and the chairman of the firm has stated that, from a mining point of view, the future is uncertain.

MALAYA—**Southern Malayan Tin Dredging** has completed check drilling of the western area of the Degong Road section and results generally confirm values previously indicated. It is expected that this property will be profitable, although it is recommended that initially dredging should be confined to an area of about 520 acres containing some 59,000,000 cubic yards with an estimated recoverable value of 0.33 pound tin per cubic yard. There is also a 260-acre area of lower value which could be worked when conditions warrant. It is unlikely that the No. 5 dredge will be transferred to this property before the end of the year.

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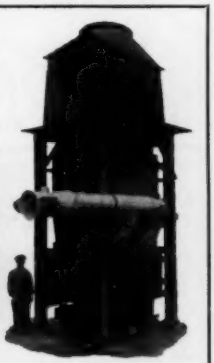
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1—5' x 10' Denver Ball Mill

JAW CRUSHERS
4—2¼" x 3½" New Morse Lab Crushers
3—4" x 6" New Morse Lab Crushers
1—5" x 6" New Morse Jaw Crusher
1—6" x 7½" Hendy Crusher
1—8" x 12" Universal 2M
1—8" x 16" Kue-Ken No. 30 Crusher
1—10" x 20" Pacific Crusher
1—20" x 36" Diamond Roller Bearing, Steel Plate, Jaw Crusher

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1—4 Ton General Electric Battery Locomotive
1—6 Ton Goodman Trolley Locomotive
1—6 Ton Jeffrey Trolley Locomotive
2—6 Ton General Electric Battery Locomotives
1—7 Ton Jeffrey Trolley Locomotive
1—7 Ton Atlas Battery Locomotive
2—8 Ton General Electric Battery Locomotives
3—8 Ton Ironton Battery Locomotives
1—9 Ton Whitcomb Battery Locomotive
4—10 Ton Atlas Battery Locomotives
2—10 Ton Jeffrey Trolley Locomotives
1—13 Ton Jeffrey Trolley Locomotive
1—13 Ton Goodman Trolley Locomotive
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1—2" Hill, 4 stage, 75 gpm, 350' head
1—2" Byron-Jackson, 2 stage, 125 gpm, 125' head
4—2½" Pennsylvania, 4 stage, 140-200 gpm, 400-570' head
1—2½" Pennsylvania, 6 stage, 150 gpm, 640' head
1—2½" Buffalo, 4 stage, 250 gpm, 440' head
1—3" Worthington, 2 stage, 500 gpm, 550' head with 100 HP G.E. motor
1—3" Allis-Chalmers, 3 stage, 400 gpm, 250' head
1—3" Hill, 3 stage, 250 gpm, 200' head
1—3" Buffalo, 4 stage, 250 gpm, 600' head
2—3" United, 5 stage, 110-350 gpm, 550-600' head
2—3" Union, 6 stage, 260-350 gpm, 630-700' head
3—3" United, 6 stage, 180-350 gpm, 700-900' head
1—4" Platt, 2 stage, 250 gpm, 110' head
1—4" Ingersoll-Rand, 2 stage, type 4GT2, 1000 gpm, 920' head with 300 HP G.E. motor
1—5" Manistee, 8 stage, 450 gpm, 865' head
1—6" Byron-Jackson, 3 stage, 1000 gpm, 1592' head with 500 HP G.E. motor

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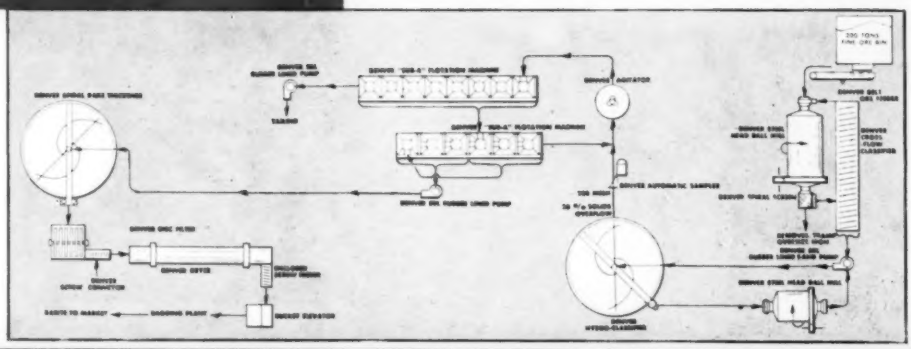

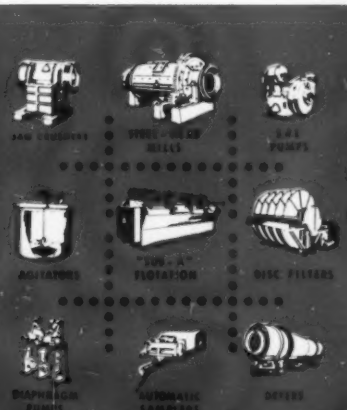

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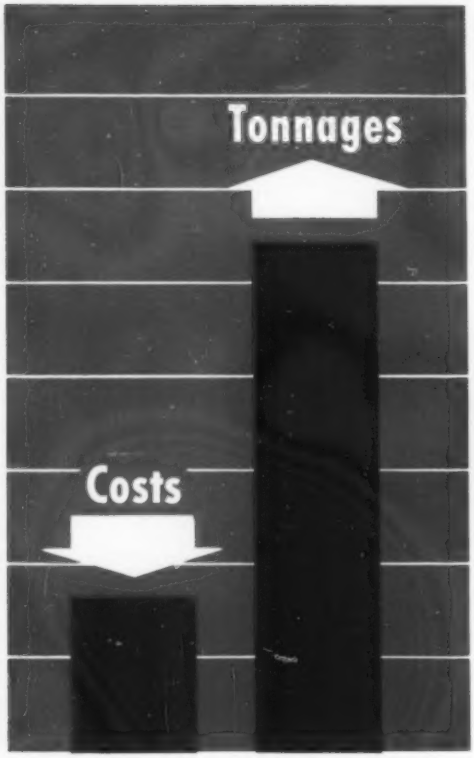

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